the work, and at the end of the reign of George III the principles of medical control in the navy under one authority were well established, and have served as the model for all subsequent changes.

BONE GRAFTING IN GUNSHOT FRACTURES OF THE JAW.

BY

WILLIAM BILLINGTON, M.S., F.R.C.S.,
CAPTAIN R.A.M.C (T.F.),

ARTHUR H. PARROTT, M.D.S., L.D.S., AND HAROLD ROUND, M.D.S., L.D.S.

FOR rather more than two years we have had charge of the "Jaw Department" at the 1st Southern General Hospital, Birmingham, to which all cases of injuries to the jaws requiring special treatment are sent from the whole Southern Command. A very large percentage of these cases suffer from compound fracture of the mandible. Successful treatment involves (1) osseous union, (2) functional occlusion, and (3) avoidance of disfigurement.

In the majority of cases these results have been obtained by means of mechanical technique associated with due regard to the establishment of aseptic conditions. In some, however, satisfactory results cannot be obtained by this technique alone. Where there is a gap between the bony fragments greater than half an inch osseous union is rarely obtained unless (1) the fragments are allowed to approximate at the expense of normal alignment, or (2) a bone graft can be successfully introduced.

The gap between the fragments may be due to extensive loss of bone at the time of the injury or to subsequent necrosis from resulting sepsis. Sepsis in these cases is always severe and unless adequately combated in the early stages may be extremely persistent.

It is essential that firm osseous union should be obtained even at the expense of deformity, otherwise the power of mastication is gravely impaired. When, however, the gap is wide, the deformity resulting from allowing the fragments to approximate is so great and renders the fitting of suitable dentures so difficult that it can only be the extreme resort. A satisfactory functional and cosmetic result can then alone be obtained by successfully bridging the gap by means of a bone graft.

Other classes of cases in which surgical assistance is necessary to secure osseous union are those in which (1) there is overriding or malposition of osseous fragments; (2) mobility of the fragments from muscular action cannot be prevented by mechanical means—for example, short posterior edentulous fragments.

Operation in these cases consists in carefully dissecting away the scar tissue from between and around the ends of the fragments, rectifying the deformity by the division of contracted muscular attachments and fibrous bands, and immobilizing the fragments by means of a plate and screws. If, as is often the case, a gap remains between the fragments when pared and brought into correct alignment, a small graft is introduced, and the technique is similar to that described for bone-grafting.

Bone grafting in fractures of the jaw resulting from war injuries has presented many difficulties, and at first success was so rarely obtained that the attempt was given up and discouraged by very competent surgeons as not being worth while. The alternative of obtaining union by allowing the fragments to approximate led to so much disfigurement and such awkward mouths to fit with satisfactory dentures when the gap was a wide one that we felt compelled to persevere, especially because osseous union could not be obtained in a definite percentage of cases in spite of all sacrifice of normal alignment, etc. To discharge such cases with non-union was a confession of failure that could only be made with extreme reluctance.

The technique we now employ has been reached only after much experiment, many devices having had to be abandoned. Without enumerating the various stages through which we have passed, we think that a short account of the preparation for and the performance of the operation now in use will be helpful. Whereas success was the exception two years ago, it is now the rule, and it rarely happens that the graft fails to heal firmly.

Preliminary Preparation.

This is prolonged, and it may be many months after the original wound was received before the operation of bone grafting can be undertaken. The fracture is always complicated by sepsis, usually severe, and often by extensive injury to surrounding soft tissues. As soon as possible an *x*-ray examination should be made, after which the patient should be anaesthetized and the wound explored. Foreign bodies, teeth in and adjacent to the fracture, and loose fragments of bone should be removed. Larger fragments of bone with reasonably good attachments to soft tissues may be left in the hope that they will live. At the same time it is often possible to carry out some rough plastic work, the fragments of bone being replaced in as normal a position as possible and soft tissues being drawn together. Care must be taken to provide for efficient drainage and access to raw surfaces inside the mouth.

A more or less prolonged interval must now elapse while wounds are healing. Sepsis is apt to be persistent, and one or more subsequent operations may have to be performed for the removal of sequestra and drainage of pockets. During this interval careful attention must be paid to the maintenance of the patient's physical fitness by careful feeding and suitable environment. Much can also be done, by means of dental splints, etc., to correct or prevent displacement of the fragments of the jaw by muscular action and contracting scar tissue, even though firm bony union cannot be secured.

Finally, before attempting to bone-graft, it is very important that dribbling of saliva from the mouth should be prevented by plastic operations. This dribbling is very common when there is a defect in the lower lip, and saliva soaking into the dressings greatly increases the risk of sepsis in the operation wound.

After all wounds inside and outside the mouth have healed an interval of from four to six weeks should elapse before the bone-grafting operation is performed. During this time the patient is usually sent to a convalescent hospital.

Immediately before the operation all dental fixation splints are removed from the mouth. It was found that the retention of these militated against the success of the operation. They caused risk from post-anaesthetic vomiting, greatly added to the discomfort of the patient, and, where pressure was exerted by them in or near the operation area, increased the risk of sepsis. For these reasons, no attempt is made to fix the fragments of the jaw during the operation or for about two weeks subsequently. Everything which interferes with prompt "healing in" of the graft must be discarded.

Operation.

A skilled anaesthetist is essential, and we owe much to the skill with which Captain McCardie has maintained successful anaesthesia under very difficult conditions.

A curved incision is made in the neck beginning one inch behind the extremity of the posterior fragment and ending one inch in front of the end of the anterior fragment. The incision commences and finishes about half an inch above the line of the lower border of the jaw and in the neck runs about one inch below that line. It is only by carrying the incision well below the jaw and raising a flap that sufficient soft tissue to satisfactorily envelop the graft can be obtained. Often at the site of the fracture there is nothing but dense scar tissue which extends through to the mouth, and great care has to be taken in splitting this to avoid opening into the mouth, an accident which necessitates postponement of the operation. The unsatisfactory bed provided by this scar tissue constitutes one of the difficulties of bone grafting in these cases.

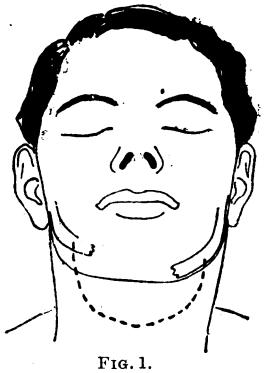

FIG. 1.

The incision is deepened by cutting upwards and inwards until the lower border of each fragment is reached. The soft tissues covering the outer surface of each fragment are then raised for an inch away from the gap and turned up in the flap. The ends of the fragments and the

fibrous tissue occupying the gap between them are now carefully cut away. Finally, each fragment is bevelled by cutting away a flake of bone from its outer surface with bone forceps. In this way raw bone is exposed at the ends of the gap and on the outer aspect of the fragments for about one inch from its extremity. All bleeding is then carefully arrested and the bone graft prepared.

After experimenting with bone from the ribs, the tibia, and from the jaw itself, the iliac crest was finally selected as the site from which to take the graft. The bone is tough and can be cut with bone forceps without splitting. Further, a graft can easily be obtained of any length or breadth and the natural slightly curved contour of the crest is approximately that of the jaw. The graft should be taken preferably from the same side as the operation wound, thus allowing the patient to lie comfortably on the opposite side.

An incision is made over the crest commencing at the anterior superior spine and extending as far back as required. The muscles are then separated on either side of the crest and pressed back by retractors. The bone is cut by an ordinary Horsley's hand saw. The graft should be two inches longer than the gap to be filled. If a more curved piece of bone is required, as to fill a gap near the chin, the graft is made to include the bone between the superior and inferior spines.

In this way a graft four inches long has been obtained which filled a gap extending from the angle of the mandible on one side to well beyond the chin on the other, and the curve was so accurate that no subsequent modelling was needed.

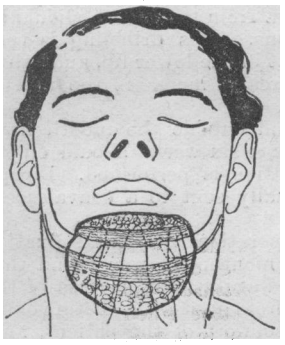

FIG. 2.

After removal of the bone the muscles detached from it are sewn together with catgut and the wounds closed. No inconvenience whatever seems to result. The ends of the graft are now bevelled with bone forceps, the bevelled areas lying on the prepared outer surfaces of the jaw fragments. In this way the graft overlaps the gap at each end for an inch. Two advantages result from this: (1) A broad line of bony contact between the graft and the fragments is provided with increased prospect of speedy firm osseous union, and (2) there is practically no risk of separation in the event of the gap being increased by subsequent manipulations during the application of dental splints, as a certain amount of sliding can take place without contact being lost.

No attempt is made to fix graft or fragments by plates and screws, by wiring, or even by dovetailing the graft into the fragments. All these measures have been tried and discarded. The presence of foreign bodies greatly militates against successful healing, a sinus down to the plate or wire almost invariably forming. Attempts also to make the graft act as a splint by dovetailing it between the fragments have not led to satisfactory results.

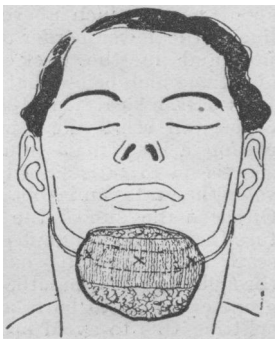

FIG. 3.

Our practice now is to keep the graft in place by sewing the soft tissues closely over the graft and the ends of the fragments by hardened catgut. This has the additional advantage of closely surrounding the graft with living vascular tissue and abolishing dead spaces in which blood clot and serum can collect. This improves the nutrition of the graft and diminishes the risk of sepsis.

Finally, the skin is approximated with a few interrupted stitches. No drainage is employed beyond that of leaving spaces between the skin sutures to allow of the escape of serum. A simple dressing and bandage is applied and the patient sent back to bed.

No attempt is made to reintroduce dental fixation splints until the wound is firmly healed and the compound fracture has been converted into a simple one. This usually occurs in two weeks, after which the case is treated as one of simple fracture of the jaw. Firm osseous union occurs in from two to four months, but it is inadvisable to fit the final dentures until at least four months have elapsed, and it is perhaps wiser to allow an interval of six months.

We intend to supply notes of cases in a subsequent paper. We desire to record our appreciation of the very valuable assistance at the operations that we have received from Captain Learmonth and Sister Dorothy Jones of the 1st Southern General Hospital.

INFLUENZA: ITS CAUSE AND PREVENTION.

BY

W. FORD ROBERTSON, M.D.,

PATHOLOGIST TO THE SCOTTISH ASYLUMS.

MANY who have read the recent writings on this subject in the BRITISH MEDICAL JOURNAL must feel there is great need that those who have had special opportunities for the study of the *Bacillus influenzae* and its pathogenic action should make public any knowledge they have that may be useful at the present time. I therefore hope that the following notes may be acceptable.

The best method of growing the bacillus of influenza seems to be still unknown, though it was described and demonstrated before a scientific society in 1916 and mentioned in a paper published shortly afterwards.[1] It has been constantly used since 1914 in the laboratory of the Scottish asylums, where it was originated by the senior assistant, Mr. John J. Ritchie. It takes advantage of the fact that the bacillus of influenza is stimulated to growth by the mere proximity of certain other micro-organisms, especially those of the *catarrhalis* group and pneumococci. In this method, which may be referred to as the alternate drill method, generally three straight drills of, say, *Micrococcus catarrhalis* are made from bottom to top of a suitable agar surface, one at each side and the third exactly in the middle. Between these drills two drills are made from colonies of *Bacillus influenzae*. Abundant growth, suitable for the preparation of vaccines, can generally be scraped off after twenty-four hours' incubation, but it is of advantage to continue incubation for two or three days.

The best medium is haemoglobin agar, which, though it has been used in the laboratory of the Scottish asylums for many years and repeatedly described, seems still to be rarely used, at least in a correct way. I obtain haemoglobin serum from sheep's blood (secured with aseptic precautions), which has been allowed to clot and from which most of the serum has been decanted. The tubes are placed for an hour or so in a freezing mixture. When thawing takes place the remaining serum contains a strong solution of haemoglobin. About 1 c.cm. of this haemoglobin serum is added to each tube of nutrient agar in the fluid state, while at a temperature of about 60° C. The medium is allowed to set in a sloping position. It is important to use a higher percentage of agar than is generally prescribed for nutrient agar. The tubes should be incubated for twenty-four to forty-eight hours before they are used for the making of cultures, in order to test their sterility. In the preparation of vaccines the culture material obtained by the alternate drill method is scraped off by means of a platinum loop and placed in 1 per cent. carbolic acid in normal salt solution. Twelve to twenty-four hours at 37° C. suffice for sterilization. The preparation of the vaccine is completed by the gravimetric method. It is greatly to be deplored that bacteriologists should still adhere, with false conservatism, to the inaccurate, time-absorbing and inconvenient plan of standardizing vaccines in millions. In the gravimetric method the whole batch of dried vaccine is accurately weighed in the chemical balance and made up to a strength of 1 c.cm. = 1 mg.

Influenza bacillus vaccines for use should consist of a one-tenth dilution of the emulsion in the stock tube—namely, 1 c.cm. = 0.1 mg. The dose of influenza bacillus for therapeutic immunization ranges from 0.005 mg. to 0.1 mg.