if their increased intracranial pressure had remained unrelieved.

The following case is interesting as showing how a patient may drift on from week to week with a streptococcal meningitis.

CASE III.

Private M. was admitted on August 8th, 1915, with a history of having been wounded seven days previously by shell fragments.

Wound.—A dirty gutter wound 2 in. in length immediately behind pinna of left ear.

X-ray examination showed a bone defect of considerable extent under wound, with indriven pieces of bone and many shell fragments lying in the brain substance at varying distances from the wound of entry. The patient was trephined on August 9th, 1915. Fragments of bone were removed from the brain substance underlying the wound. No attempt was made to reach the shell fragments; wound too septic to allow of its being floored in.

Manometer Readings.

Date.	Clinical Condition and Condition of Wound.	Initial Pressure.	Quantity and Character of Fluid Removed.	Pressure after Removal of Fluid.
1915. Aug. 14	Complaining of intense headache. Some hernial protrusion through wound	46.5 cm.	5 vi of turbid fluid removed, containing many leucocytes. Streptococci in pure culture	22 cm.
Aug. 15	Still has intense headache. Temperature high	66.5 cm.	3 x of turbid fluid mixed with blood removed	Not taken.
Aug. 17	High, irregular temperature. Hernia increasing. Headache severe	58 cm.	3 (?) removed. Fluid straw-coloured, slightly turbid. It contained many cells. A few colonies of streptococci on culture	
Aug. 19	—	51 cm.	3 ij (all that could be got to run) of turbid fluid, containing many fibrinous strands, removed. Fluid contained many leucocytes	
Aug. 21	Patient no worse	44.5 cm.	3 v of almost clear straw-coloured fluid removed. Very few colonies of streptococci on culture	
Aug. 26	Semi-conscious. Increasing hernia cerebri	108.5 cm.	3 v removed. Fluid opaque and straw-coloured. It contained a few flakes of dense white fibrinous material	16.5 cm.
Sept. 1	Semi-conscious. More hernia cerebri	65 cm.	3 viij of turbid fluid containing many white shreds	
Sept. 5	Patient unconscious, temperature high, pulse weak. Patient died			

Our comment on this case would be that it is only rarely that a case of streptococcal meningitis lives as long as three weeks. His condition appeared to improve steadily up to August 21st, 1915, when the fluid, which had been turbid, was almost clear, and if only he had been tapped on one or two occasions between this date and August 26th, when the pressure was so high (108.5 cm.), we might conceivably have saved him.

It has seemed to us, after a lengthy experience of these more chronic cases of septic meningitis, that the virulence of the disease, both as manifested by the patient's clinical condition, and also by the number of cells, organisms, etc., in the fluid drawn off by lumbar puncture, shows a tendency to wax and wane, as if, from time to time, owing to the breaking down of adhesions, fresh showers of organisms were conveyed from the local site of infection—that is, the wound—to the meninges at large; just as in the more chronic cases of miliary tuberculosis successive showers are conveyed at varying intervals from the local lesion, it may be a caseating patch in the lung or a broken-down gland, to the blood stream and the various organs of the body.

It is with this factor in view that we should endeavour to secure and maintain efficient external drainage of the wound, even when there is a generalized meningeal infection.

That lumbar puncture, even, is not always without its attendant risks may be illustrated by the following fatal case following its use:

CASE IV.

Private S. was admitted on December 31st, 1915. The wound, a fairly clean punctured wound, was situated in the frontal region.

X-ray examination showed a track leading from the wound of entry down to the occipital region, where lay several shell fragments embedded in the under aspect of the right occipital pole.

An operation was performed on January 3rd, 1916. The wound of entry was cleaned up and pieces of bone removed from the brain substance. No effort was made to remove the shell fragments. The patient was well until January 7th, 1916, when he complained of severe headache. After that he had a steadily rising temperature and some hernial protrusion through the wound of entry. Lumbar puncture was performed under general chloroform anaesthesia. The initial pressure of the fluid was 53 cm. After about 5 fluid drachms of clear fluid had been removed, it began to become increasingly blood-stained, the last drachm containing almost pure blood. Almost immediately the needle had been withdrawn the patient suddenly became intensely cyanosed and his respiratory movements spasmodic, long irregular intervals occurring between each aspiratory effort. In spite of this, however, the pupils remained contracted and the pulse-rate normal and of good volume. Artificial respiration and the inhalation of oxygen produced no effect, and finally, about an hour after the commencement of the attack, he died, the pupils having dilated widely, and the pulse having given out a moment before death.

The autopsy, performed by Captain Henry, R.A.M.C., showed a septic track leading from the wound of entry to the under surface of the right occipital pole, where there lay several large fragments of shell casing. The under surface of the right occipital lobe was bathed in a large quantity of recently-shed blood. Secondary haemorrhage had occurred from the ragged torn end of a small cortical vessel lying on the under surface of the track.

We may reasonably assume that in this case it was the sudden removal of a certain quantity of supporting cerebrospinal fluid that had just been sufficient to start the haemorrhage.

Except for this unfortunate accident, and the other case already described, in which fatal meningitis followed the rapid involution of a hernia after lumbar puncture, we have had no death attributable, either directly or indirectly, to the performance of lumbar puncture.

I am much indebted to Lieutenant-Colonel Sargent, R.A.M.C., and Lieutenant-Colonel Gordon Holmes, R.A.M.C., for their help in the preparation of this paper, which is largely a result of their work. My thanks are also due to Lieutenant-Colonel Ellery, R.A.M.C., Officer Commanding the Hospital, for permission to make use of the notes of cases treated there.

REFERENCES.

¹ Sargent and Holmes, Treatment of Penetrating Wounds of the Skull, *British Journal of Surgery*, vol. iii, No. 11, 1915. ² Proceedings of the Royal Society of Medicine, vol. iv, pt. 1, Clinical Section, p. 56.

TREATMENT OF FRACTURED MANDIBLE
ACCOMPANYING GUNSHOT WOUNDS.

BY

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THE object of this article is to call attention to some methods of treating fractures of the mandible resulting from gunshot injuries, the more so since very few if any of those described in textbooks are suitable.

In a fractured mandible caused by gunshot there is practically always an external wound or wounds, though in not a few cases the bullet seems to have entered through the mouth. The fracture is always compound, and there is more or less loss of bone through comminution or actual carrying away of a portion of the mandible.

The result of such an injury is primarily to exaggerate considerably the typical displacements usually seen in civil practice. Any splint or other remedial treatment should be designed to correct such displacements, and it is necessary to recognize what these are likely to be.

Fractures of the anterior portion of the jaw involving the incisor region lead to (1) narrowing of the arch of the jaw; and (2) twisting inwards of each horizontal ramus, brought about chiefly by the action of the mylohyoid muscle.

Fractures of the posterior portion of the mandible lead to (1) considerable elevation of the posterior fragment (temporal and masseter muscles); (2) retraction and deflection of the chin; (3) depression of the larger fragment on the injured side. (2) and (3) are due to the unopposed actions of the genio-hyoid, genio-hyoglossus, and mylohyoid muscles.

As part of the conditions bearing upon treatment, it has to be remembered that many of the men have either (1) lost a large number of teeth; or (2) have a number of septic teeth present; or (3) were wearing dentures, which disappeared at the times of the injury.

These being the conditions, it is necessary to select some method of treatment which will conform to them and which will reduce any future deformity or disability to a minimum.

In the first place I will briefly review the better known methods and splints, and show in what way they fall short of requirements.

I. The Four-tailed Bandage.

This is worse than useless, since it in all cases (except simple fractures) further retracts the chin, increases the displacement, and causes increased laceration of tissue. Further, if tight it is very painful, and if loose it does not immobilize.

II. Interdental Splints.

There are general objections of a serious nature to all these. First, they require a plaster cast to be taken of the parts—a difficult and painful proceeding. Secondly, they require to be specially made for each individual case. Thirdly, to carry this out the services of trained specialists and special equipment of a cumbersome nature are required. Fourthly, the majority of such devices are unsuited to the nature of the injuries and do not control the displacements.

1. The *Hammond (wire) splint*, perhaps the best-known of interdental splints, cannot control either the marked upward displacement of the posterior fragment, nor prevent the inward tilting of fragments in anterior fractures. Moreover, its use necessitates the presence of a very large number of sound natural teeth.

2. The *Gunning splint*, and its modification the *cradle splint*, are unsuitable for posterior fractures; their use may result in permanent "open bite"; they are cumbersome and keep the mouth permanently propped open.

3. The *"Kingsley" splint* is perhaps the best form of interdental splint; it will effectively control all displacements. The sole objections to it are those attaching to the fact that it must be specially made for each case.

4. The *"Ottolengui"* and similar metal cap splints are unsuitable owing to the tediousness of their manufacture for every individual case.

III. Plate and Screws and Wiring.

Plating is, of course, inapplicable owing to the sepsis and to the space frequently existing between the ends of the bone. Wiring may be utilized with advantage in those cases in which the loss of tissue has not been too great. But when there has been much loss of bone, to draw the two ends together and wire them would either be impossible or grotesque, and would not result in a jaw which could be used subsequently for mastication. This method may, however, be employed in a modified manner as described below.

SUGGESTED IMMEDIATE METHODS OF TREATMENT.

In view of the conditions of the injury and the disabilities pertaining to usual methods of treatment outlined above, I have utilized the following methods and found them quite satisfactory:

1. Splint.

From what has been written above it might be inferred that I would not suggest the use of any form of splint, but in the one to be described it is believed all the enumerated objections have been overcome, with the added gain of extreme simplicity.

The splint advocated is a modification of the Kingsley splint. It has been adopted by the New Zealand Government (Defence Department) and supplies have been sent to the front for use chiefly on hospital ships.

The accompanying illustrations demonstrate the design and use of the splint. It is made of metal—nickel-silver, gilded—and consists of a body and two arms (Fig. 1). The body is concave and moulded to the shape of a dental arch. The arms are made of stout wire soldered to the body. The concavity is filled with old "modelling" composition. The splints are made in three sizes—small, medium, and large.

FIG. 1.—Writer's modification of Kingsley splint, showing concavity, which is filled with "modelling" composition.

The following are the instructions sent out with each set of splints:

The "Pickerill" Splint.

This splint is a modification of the "Kingsley" splint for fractured mandibles. The modification provides a ready-made splint for any case, instead of a special dental splint having to be made to fit each individual case. It can be used for simple and compound fractures, and also in cases when a portion of the bone is missing, to maintain the relative position of the two fragments, and especially to counteract the upper displacement of the posterior fragment, which in such cases always renders any subsequent prosthetic operations difficult or impossible, and more or less incapacitates the patient for life.

It can be removed and replaced without difficulty for dressing wounds. It requires no special technical skill for its adaptation. It may be used advantageously in combination with "wiring."

Directions for Use.

1. Splints are provided in three sizes—large, medium, and small. Select one which is of the approximate size required.

2. Remove the red composition by placing the splint in hot water.

3. Try the splint in the mouth over the teeth. If it is too deep at any point, trim it down with the scissors provided, leaving no sharp edges. Any other adaptations required may be made with the pliers provided.

4. Heat the composition in hot water and replace in the dried and warm splint. Whilst the composition is still warm press the splint down into position over the teeth and jaw, observing—

(1) That the composition is not too hot, or the subsequent removal of the splint may be difficult.

(2) That the fragments are in normal position.

5. Pass a bandage under the mandible up between each arm of the splint and the cheek, over the arm and down under the mandible, and there tie it firmly. The jaw is thus securely clamped (Fig. 2).

(A pair of pliers and a pair of small metal-scissors are sent with each batch of splints.)

FIG. 2.—Writer's splint in situ.

2. Intermaxillary Lacing.¹

This consists essentially in absolutely immobilizing the lower jaw by lacing it up to the upper jaw by means of wire ligatures around the teeth.

The following is the method used and described by the author.² The ligatures should be of silver or copper-gilt wire (gauge 21 or 20 B.W.G.), and the premolar teeth are the most suitable to which to affix them. These teeth are not so far back as to be inaccessible, and the comparative narrowness of their necks makes them useful for retaining the ligatures (see Fig. 3.) Two horizontal ligatures are first passed through the interdental spaces between the canine and first premolar, and the second premolar and first molar in both jaws, so as to include both premolar teeth. This should be done on both sides of the jaw. The horizontal ligatures on either side are then connected by vertical ligatures, all the wires being applied quite loosely.

FIG. 3.—Intermaxillary lacing, showing method in which it may be employed for the "permanent" treatment of fractures of the mandible.

The horizontal wires are next tightened, and then the lower teeth are made to articulate absolutely accurately with the upper teeth, and whilst in this position the vertical wires are tightened and the jaw thus immobilized. The method may be used as a temporary measure in all fractures of the mandible, in which cases ligatures of silk

or silkworm gut may be placed round the anterior teeth, as shown in Fig. 4. This affords the patient much relief, and is much more reliable than a four-tailed bandage.

FIG. 4.—Intermaxillary lacing, showing method in which the principle may be used as a temporary measure to prevent the depression and falling back of the chin.

The method may also be used as an adjunct to the open surgical methods of wiring the fragments, when fixation of the temporo-maxillary joint may be desirable for a time at least. Even if all teeth are present, the patient does not suffer from inability to take sufficient nourishment. There is always sufficient space between the teeth and behind the last molars for liquid food to pass. Patients do not suffer very much from a diet of milk, porridge, arrowroot, soup, etc., for five or six weeks. In a similar way a patient can use an antiseptic mouth-wash and use the tongue as a toothbrush on the lingual surfaces of the teeth.

The vertical wire ligatures may be left on for three weeks, after which in some cases they may be removed and passive movements allowed; they may be replaced by silk ligatures, as being easier to apply. A vertical ligature should be continued until the sixth week, especially during the time or times the patient sleeps, in order to prevent yawning, as the latter does far more harm than even a slight amount of mastication.

Another method of intermaxillary lacing is by means of "Angle's bands." These bands, either made or procured, are clamped to the teeth by means of a thread and nut. There are studs on the buccal surfaces round which ligatures are passed in order to bind the two jaws together.

Absence of teeth is no bar to intermaxillary lacing. When teeth are absent or so carious as to be useless for retention of ligatures I proceed as follows:

1. Holes are drilled through the jaw at the level of the roots of the teeth, and about three-quarters of an inch away from the ends of each fracture line. Stout silver wire is then passed through the holes and the fragments approximated if possible.

2. Further holes are drilled in the region of the lateral incisors of both upper and lower jaws, or other suitable positions, according to the site of the fracture, and a silver wire passed through both. The mandible is brought into the normal or desired position, and the wire tightened by twisting. The upper jaw is thus utilized quite satisfactorily for immobilizing the lower jaw.

3. Submandibular Screws and Wire Splint.

In cases in which none of the other above described methods are available for some reason, such as an extremely septic mouth or the loss of much of the alveolar processes, the following method may be adopted:

1. A very stout piece of German silver (or even iron) wire is obtained and bent to the shape of the lower border of the mandible—as the latter should be normally, and extending from angle to angle.

Four steel screws 1 in. or 1½ in. long, and preferably nickel-plated, are required, and some fine silver or brass wire for ligatures.

2. The skin under the mandible is sterilized, and four small incisions are made directly over the lower border of the bone, two on each side of the fracture line (avoiding, of course, the facial arteries). Holes are bored in the bone for the reception of the screws, and the latter are then screwed in firmly for a depth of about half an inch.

The stout wire splint is then ligatured securely to the four screws with the fine ligature wire, and the mandible is securely clamped (Fig. 5). Every effort should be made to prevent infection reaching the screws, or they may become loose before the fracture has united. It is an advantage to have the wire "splint" nicked each screw to prevent the ligatures from slipping.

FIG. 5.—Submandibular screws and wire splint. The transverse wire is auxiliary to the main curved wire, and may not be necessary. The fine wires ligaturing the wire "splint" to the screws are not shown.

frequently with a file near each screw to prevent the ligatures from slipping.

4. Wiring.

This method is desirable under two conditions:

1. When there is not much loss of tissue, and the fragments can be reasonably approximated.

2. When there is an appreciable loss of bone, and the fracture is so far back in the mandible that it is difficult or impossible to control the posterior fragment.

A wire may then be utilized, not so much absolutely to approximate the two ends, but to prevent the posterior fragment being so much elevated as it otherwise would be. Thus the bar of fibro-cicatricial tissue is considerably shortened, there will be more power in that side of the jaw, and the subsequent fitting of dentures may be done with less difficulty and with more chance of their being efficient and functional. For practically all fractures of the horizontal ramus the operation can be performed wholly from within the mouth. The difficulty, or otherwise, and success of the operation depends entirely upon the amount of swelling and sepsis present. Where this is marked and this method of treatment is deemed most suitable for the case, I prefer to immobilize the jaw by temporary intermaxillary ligatures for some days or a week, whilst antiseptic mouth washes are being used and the wound cleaning up. The method then employed is to drill through the bone between the roots of the teeth about half to three-quarters of an inch away from the fracture on either side, with a suitable drill. (For fractures in the premolar or molar region a "contra angle" bandpiece is used in the engine.) In order to mark the site of the perforation the drill is dipped in pure carbolic acid. Well gilded copper wire is then passed through the holes,* and tightened by twisting the ends, which are cut off and covered with either gutta-percha or fine rubber tubing. It is then advisable, wherever possible, to supplement this single suture by either interdental or inter-maxillary lacing in the neighbourhood of the fracture.

The wire suture should be removed (by being cut) at the end of six weeks. This may require a general anaesthetic, but it can usually be done under cocaine. This method has the advantage of being rapid, simple, and inexpensive.

Precaution.

Care should always be taken to clear out any comminuted fragments of bone from the wound at the time that the injury is treated by splints, or wiring, or lacing, otherwise, of course, union will be prevented, or a sinus will continue discharging long after the soldier might have returned to duty.

Treated by one of the above methods, there is no reason why many men whom one sees at present more or less totally incapacitated (from a military point of view) should not be back in the firing line in six weeks from the date of injury.

REFERENCES.

* See author's *Stomatology*, London, 1912. ² BRITISH MEDICAL JOURNAL, 1909, ii, p. 882

THE TREATMENT OF CHLORINE GAS POISONING BY VENESECTION.

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In the BRITISH MEDICAL JOURNAL for May 27th, 1916, Professor Sir E. A. Schäfer writes that venesection might be tried in acute poisoning by chlorine gas. As the result of the attacks on April 27th and 29th of this year in front of Hulluch, in which chlorine gas was used by the Germans, I had the opportunity of treating a number of cases. As the patients arrived in a condition requiring more drastic treatment than the mere inhalation of ammonia or the injection of atropine, I tried the effect of venesection, and was so struck with its effects that I began to adopt it as a new line of treatment in specially selected cases; only those of the cyanotic type with much distress but with a good pulse were bled.

Selection of Cases.

Venesection is not required for all cases. The two types I called the "cyanotic" and the "cardiac failure." The latter are pallid, collapsed, and require no bleeding. They

* It is sometimes stated that there is considerable difficulty in returning the wire through the holes, but with a few common-sense precautions this is really a very simple matter.