An Address

ON

INJURIES TO THE PERIPHERAL NERVES
AND THEIR TREATMENT.*

BY

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NATURE OF INJURIES.

The lesions of nerve trunks as the result of wounds may be of diverse forms.

I.

In the majority of cases the nerve trunk has not sustained a primary injury. It may be exposed in greater or less degree in a wound of the soft parts with or without fracture. If the wounds are gravely infected and suppuration occurs with, perhaps, necrosis of one or of many fragments of bone, the process of healing may be long delayed, and the cicatricial tissue which results will be of exceeding density. The nerve then may come to lie in the midst of a fibrous mass which, undergoing progressive contraction, presses more and more firmly upon the delicate and tender tissue of the nerve. The nerve trunk is strangled, bereft of its due supply of blood, and becomes in consequence functionless. It is impossible before operation to decide in the severer cases whether such a nerve has or has not been completely divided.

II.

The nerve fibres may not have been directly, or they may have been only very trivially implicated, but the projectile may have passed so near the nerve trunk as to have opened its sheath. The nerve then becomes adherent to the track of the missile, and a mass of fibrous tissue is found firmly welded on to its lateral aspect. Or the projectile, in this case a rifle or machine-gun bullet, may at that period of its flight when it has become steady have cleaved through the trunk of a nerve separating the fibres and severing few or none. Haemorrhage within the sheath occurs and a fibrous mass develops in the centre of the nerve, causing it to assume a fusiform appearance. There is then a *central neuroma*.

III.

The nerve may have been partly severed, say in half its diameter, by a projectile, or a fragment of bone. The gap in the nerve is soon filled up by fibrous tissue, which extends widely upwards and downwards and away from the side of the nerve, so that a hard fibrous *lateral neuroma* is found.

IV.

The nerve may be completely severed. In such a case a gap of greater or less length is found between the divided ends. Bridging this interval there may be a connecting strand of fibrous tissue, or a blurred mass of scar material in which both cut ends are lost. In some cases the nerve may appear hard and swollen, and as though its fibres were continuous; but careful dissection will show that there is complete division.

When the nerve has been cut completely across the upper divided end is soon found to present a characteristic bulbous appearance. On section this is seen to consist partly of fibrous tissue and partly of nerve tissue. From the upper end of any divided nerve the axis cylinders grow downwards tirelessly, each one searching out diligently but blindly the lower end to which it seeks to unite. When the quest fails in one direction and an uncongenial tissue is met, the axis cylinder turns in another direction, searching there fruitlessly again, and so twists itself in ceaseless contortion until a tumour, a *terminal neuroma* is formed.

The fibrous mass, often of extreme density, which goes to the making of the bulbous end is probably the reply of tissues to the contact of exposed nerve fibres with them. The peripheral nerves are intruders among the other

tissues of a limb, reaching them by a process of invasion from without. The contact of these nerve fibres with any other tissue is prevented by their closure within a sheath whose function appears to be that of an insulator. The end organs of the sensory nerves may indeed be, as W. Trotter suggests, a special mechanism for isolating the nerve fibres, protecting them from actual contact with the tissues. Whenever the nervous system is injured, by accident or design, as in the operations of trephining and laminectomy, there is always a hasty and adequate attempt to isolate the parts again. There is an intolerance of the tissues for contact with nerve matter or conversely of these with other tissues.

Gosset says that the axis cylinder is very unintelligent. I am not sure that its search for the distal end is stupid because it is unsuccessful. The search is zealous enough, but the axis cylinder shrinks from ignoble conduct with a baser tissue, and turns aside to seek elsewhere.

The lower severed end becomes thickly covered with a fibrous cap which forms a barrier impenetrable by the axis cylinders seeking so earnestly to find their way along the distal nerve.

1. THE NERVES INJURED; RELATIVE FREQUENCY.

The relative frequency of affected nerves has in our experience been as follows:

	Per cent.
Musculo-spiral	25
Ulnar	24
Median	14
Sciatic	12
External popliteal	12
Internal popliteal	1
Upper portion of the brachial plexus	4
Lower portion of the brachial plexus (cords)	7
Anterior crural	1

This corresponds fairly accurately to the experience recorded by Gosset and by Tinel.

2. DIAGNOSIS.

The following points in the clinical histories are investigated:

Date of injury.
Nature of projectile.
Position of patient at moment of injury.
Immediate effects.
After-history (including history of operations performed).

Physical examination consists in—

A. Inspection of the limb, to note—

1. Attitude, contractures (claw hand, etc.).
2. Position of wounds and scars.

B. Testing of the efferent impulses.

1. Motor weakness for paralysis, each muscle and each muscle group tested separately.
2. Trophic and vasomotor disturbances. Non-shedding of epidermis, "glossy skin," ulcers, changes in nails, etc.
3. Changes in deep tissues, for example, muscular atrophy, fibrillation, bone decalcification, etc.

C. Testing of the Afferent Impulses.

1. Pain, its character, distribution, relation to hot and cold applications or weather.
2. Loss of cutaneous sensibility, tested by standardized stimuli of special instruments so that results are strictly comparable.
Light touch.
Localization of spot touched.
Tactile discrimination (pressure, texture, etc.).
Stereognostic sense (size and shape of three dimensions); appreciation of compass points applied simultaneously.
Thermal stimuli (hot and cold test tubes).
Painful stimuli (pinprick controlled by standardized spring).
Roughness (Graham Brown aesthesiometer).
3. Deep sensibility.
Pressure pain.
Vibration sense in bones.
Joint and muscle sense, etc.

D. Electro-diagnosis.

The reactions to the interrupted current are tested by shocks from an induction coil, the electrode being placed upon the "motor point" of each muscle in turn. The current from a secondary coil is always used.

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A positive reaction to faradism is regarded as a contra-indication to operation, but failure to respond gives no definite information, for voluntary movement may return, after nerve injury, before the faradic response.

The muscles are next investigated by a constant current. "Polar changes" have been found to be of minor value; they may vary with the local circulatory changes following massage, etc. The character of the contraction is of much more importance. A brisk twitch indicates the probable presence of some conducting nerve fibres in the muscle tested, while a slow "vermicular" response is usually associated with a complete interruption of nerve fibres.

The nerve muscle is next examined by means of a condenser discharge. The method depends upon the fact that a condenser discharge through a constant resistance gives a current which varies in duration according to the capacity of the condenser used.

The more severe the damage to the nerve the greater will be the capacity of the condenser required to excite it. Or, in other words, the longer the duration of the current the more chance is there of obtaining a response in such a nerve muscle. The whole advantage of the condenser method is that a definite measurement of current or condenser used may be noted, and future progress may be accurately followed.

The condenser method is chiefly used in cases where operation is deferred because some function is found to be present in a given injured nerve. (The work done recently by E. D. Adrian and others shows that the condenser is disappointing in practice; but it nevertheless gives useful information in recording progress.)

Complete absence both of faradic and galvanic response is an indication for early operation. The cases which require careful and repeated examinations are those where there is pressure on the nerve trunk by a contracting scar. In some nerve trunks there is little damage to some of the fibres, with total loss in others. Operation must not be deferred too long in these cases, because the fibres with complete reaction of degeneration may never recover on account of a dense scar tissue formation at the site of injury. In other words, the presence of a degree of voluntary power in some individual muscles of a group supplied by a damaged nerve is no sure criterion that the paralysed muscles will recover without operation.

It is most important that nerve injuries should be re-examined at frequent intervals and carefully detailed records of motor power, sensory changes, and electrical reactions kept. In this way treatment may be modified according to progress.

In operations upon nerves where a diagnosis of total loss in some fibres only has been made it is our practice to test the exposed nerve both above and below the site of injury at the time of operation.

For this examination special sterilizable electrodes and long connecting cords which can be boiled are used. The nerve is gently lifted upon two small glass hooks and a very weak faradic current employed.

The most accurate anatomical arrangement of fibres may be noted by this means and the knowledge used to secure perfect adaption in nerve suture. The diagnosis is often completed during a period in which massage, baths, and electrical treatment are employed to improve the local circulation, and splint treatment adopted to relax affected muscle groups and to overcome contractures. The distinction between anatomical and physiological division is not made before operation.

Difficulties in Diagnosis.

The main difficulties encountered in arriving at an exact diagnosis are in cases where there are:

- Wasting and stiffness from disuse.
- Circulatory disturbances.
- Contractures.
- Destruction or adhesion of muscle and tendon.

Operation is decided upon in the following circumstances:

1. In cases of complete division.
2. In cases of incomplete division, where progress is arrested.
3. Where there is severe neuralgic pain, "causalgia."

Operation is deferred—

1. For one month after the closure of the wound where soft parts only are injured.
2. For two or three months after complete closure of the wound where bone has been involved.
3. Definitely so long as progressive signs of recovery in nerve functions continue.

The suture of the nerve may have to be delayed until unsatisfactory joint conditions are improved.

Contractures of the knee, for example, should be corrected before the sciatic nerve is sutured, otherwise the nerve would be in danger of rupture if the deformity were subsequently rectified.

In other cases the nerve may be sutured and the joint dealt with at the same period and subsequently.

It is of the first importance to start active measures to prevent or remove stiffness and deformity in the parts supplied by a wounded nerve. This can often be done for many weeks before it is possible to repair the nerve. It is not sufficiently realized that a nerve to be of use after suture must act upon live and supple tissue. Joints and muscles must be kept ready for the nerve impulse which some day will come to them again.

Operations.

When the diagnosis of a nerve lesion requiring operation has been made, the earliest prudent occasion must be chosen for operation. In both the French and British armies nowadays the suture of a divided nerve is performed in those most advanced operating centres where the first deliberate toilet of the wound is possible. It is realized, of course, that very often a complete union between the severed ends cannot result, but even if the operation prove eventually to be a complete failure the subsequent operative procedures are certainly easier, and it is a satisfactory thought that a chance has been given for healing to take place.

In the great majority of nerve lesions dealt with up to recent times the wound inflicted by the projectile has suppurated. We have learnt by bitter experience in this war what this means. It means that the bacterial flora in such a wound are numerous, and potentially at least of great malignancy. It means that even a simple operation upon a wound which still discharges pus may arouse a flaming infection and be a cause of tetanus or gas gangrene. Mere passive movement of a joint grown stiff by inactivity may bring about an attack of tetanus even though the adjacent wound has healed. In many cases an injury to bone may have been inflicted at the same moment as the division of the nerve; this is, of course, frequently the case when the musculo-spiral nerve is implicated. Many loose pieces of bone may remain as sequestra in the wound and may need removal or may escape spontaneously from time to time. In all such cases operation upon the nerve must be deferred until the wound has been soundly healed for some weeks; no rule is more binding upon the surgeon than that. During this period, which may be protracted, the most diligent attention must be given to the limb, especially to those parts, muscles and joints, distal to the injury. The paralysed muscles must be kept in a position of relaxation. This may be easy, as in those cases where the musculo-spiral nerve is divided; it is often difficult, as in cases of injury to the median nerve; it is sometimes impossible, as in dual or triple lesions of nerve trunks. But, difficult or easy, the best possible must be done, for the final functional result in respect of quality and of rapidity depends in no small degree upon the early care of the parts deprived of their nerve supply.

Special and unremitting attention is given to the joints, which must always be kept supple. It is remarkable how quickly the fingers, for example, become so stiff that forced movement is an agony. Every day, many times a day, all the paralysed parts must be freely moved to their full range, and the patient must be instructed to attend to this matter unceasingly. The most perfect nerve healing is robbed of its value if, through long disuse, the muscles whose innervation is restored have lost their power to act, and if the joints are so firmly ankylosed that even passive movement cannot bend them fully. The value of these preliminary and preparatory measures cannot be over-estimated.

When the operation actually takes place it is important

to observe certain essentials to success. There must be the most perfect and scrupulous asepsis and the most gentle handling. The finger should never be placed in the wound. All dissection should be carried out deftly and neatly; the most diligent care must be taken never to bruise the nerve by seizing it, however gently, in forceps. The nerve must never be twisted, or torn or stretched, or unduly separated from its bed. Other structures must be dissected from the nerve; the nerve must not be dissected from them. The nerve must not be stripped bare for too long a distance, otherwise it will be devascularized, and recuperative processes will be slow or absent. The wound as a whole, and the nerve in particular, must not be allowed to dry or to be chilled. The most dainty and precise movements are necessary throughout, and every bleeding point must be thoroughly secured. There are, of course, the observances that go to make up the ritual of every well-trained surgeon; their strict acceptance is more necessary here than in almost any other operation, if the most rapid and the most flawless recovery is to be made certain.

As a rule a tourniquet is undesirable, for two reasons: It is possible to harm the nerve, or other nerves in the limb, if the rubber band is applied too tightly, and for the long period sometimes necessary in this procedure; and when the operation is complete and the tourniquet removed, there will probably be an escape of blood into the wound—a thing in these cases most undesirable. In these wounds not infrequently there is a good deal of young fibrous tissue, from which free oozing may occur in the period of hyperaemia which follows removal of a tourniquet.

The incision is designed to fall on the skin at some distance from the original wound if possible; very often a flap will occur from the making of a curved incision. The planning of the incision gives scope for one's knowledge of anatomy; it is so arranged that no small nerves are wounded. Major Jamieson has shown that when the median nerve is injured in the forearm it may sometimes be more thoroughly and successfully dealt with from the outer instead of from the inner side of the flexor carpi radialis. So, too, when the musculo-spiral nerve has been injured high up on the outer side of the forearm, Dr. Cuthbert Morton suggests that instead of cutting through the outer head of the triceps it should be reflected complete from the humerus. Not only does this cause less damage to the muscle tissue, but it also exposes the nerve and its branches, as well as the profunda artery, to a very high level without undue risk.

The nerve trunk is sought above and below the point of severance, and is traced downwards and upwards to the gap. Swift, neat little cuts with a very sharp scalpel damage the tissue to the smallest possible degree. The surgeon must avoid contact of his fingers with the wound; it is clumsy and inartistic to prod about among muscles in the hope of feeling the nerve. It is his business to know before he begins these operations exactly where the nerve lies, and he should always be able to cut directly down on it. When the injured part of the nerve is exposed, it is usual to find a bridge of fibrous tissue between the ends, the proximal end being often very turgid and bulbous. If the gap between the refreshed ends of the nerve is likely to be wide, now is the time for stretching the nerve, so as to lessen the interval as much as possible. This is done with infinite gentleness and care by seizing the fibrous band between the ends and drawing steadily upwards and downwards, always remembering to make the pull in the line of the nerve trunk and to avoid twisting. The fibrous band is now split longitudinally, and then its ends are divided above in one direction, below in the other, so that to each cut end of nerve a fibrous tag is attached, by means of which the nerve ends can be drawn together. Progressive transverse cuts are now made into the nerve ends until on the cross section nothing but nerve fibres are seen. Every tiniest particle of fibrous tissue must be removed or the operation will fail. The axis cylinders coming from above must have free entry into the nerve below, otherwise in their downward development they will lose their way, and restoration of the nerve function will not take place. When the nerve ends are duly prepared they are brought into apposition with the greatest care. A series of very fine catgut sutures holding only the nerve sheath are inserted at intervals round the circumference of the nerve. A suture is never

passed through the substance of the nerve itself. In uniting the nerve ends it is of the first importance to avoid axial rotation. We know now that there is a differentiation of function within each nerve, and it is therefore strictly necessary to unite corresponding bundles of fibres. A nerve does not act as a whole, but consists of a multitude of strands each with its proper and restricted function. Unless nerve bundles which were originally continuous are brought accurately together by suture, the nerve is compelled to rearrange the functions of its several parts. This it can and no doubt frequently has to do. An examination of many cases shows, however, that a perfect and flawless recovery after a nerve suture is unusual, and it is at least a tenable belief that this inadequacy or delay in recovery is due to a want of recognition by the surgeon of all that is needed in the technical part of the operation. My colleagues on the staff of the 2nd Northern General Hospital in Leeds are obtaining results which in rapidity and completeness would have been thought impossible before the war.

There is rarely any difficulty in obtaining accuracy of apposition without tension. If, however, the nerve ends cannot readily be brought together, various procedures may be adopted to shorten the course of the nerve. The nerve may be dislocated from its bed and laid in a new and shorter line. The ulnar nerve, for example, may be brought to the front of the inner condyle. Or flexion of the limb may be enough to allow of easy approximation. In the case of the median nerve divided low in the forearm, flexion of the wrist will give an inch or more additional reach. In other cases the limb may be shortened by removing an inch or two of bone. It is desirable to avoid a subcutaneous course in all transferences to new positions. The nerve after suture should be brought to lie in a bed of healthy tissue. It must be placed between muscles, and away from all contact with new connective tissue, which will adhere to it, and hinder its union, or cripple its subsequent action.

It has been the fashion with many surgeons to surround the sutured nerve with some material supposed to have protective virtues. A piece of a vein—the saphenous, for example—is threaded over the upper cut end of the nerve before suture, and after these ends are approximated the vein is drawn downwards and made to surround the line of suture. In other cases a piece of fat dissected from near the wound, or from another part, is wrapped round the nerve, fat being supposed to be capable of insulating the nerve in its new position, or a layer of fascia may be used, or a piece of Cargile membrane. The value of all such methods is open to serious question; it is certain that they are sometimes harmful, it is doubtful if they ever help. They prevent access of blood to the nerve by new channels; they cause adhesions and compression of the nerve, and at times they are discharged from the wound almost unaltered. It is better to avoid such membranes, and to be content with ensuring that the nerve is laid along a path of uninjured tissues. Where end-to-end suture is impossible, a variety of other procedures may be attempted. A nerve graft, taken from a neighbouring cutaneous nerve, from the radial, the internal cutaneous of the thigh, or an intercostal nerve, may be used. Experience on the human subject has not yet enabled me to determine the value of this procedure. In experimental work it answers well, but I have rarely, if ever, seen a result which could be claimed as satisfactory. Colonel Mayo-Robson has had one of the very few successful cases.¹ Nerve anastomosis has been tried in a number of cases. The divided ends of a nerve are implanted into the side of a near-lying nerve, the ulnar into the median, for example. This has been done both with and without section of the nerve fibres of the intact nerve. All such procedures are worthless, and cannot be too strongly condemned. I have never seen any good come of them; indeed nothing but harm could conceivably result from section of a healthy nerve. And if it is allowed, as it must be, that a nerve consists of many separate strands, each with its own special and exclusive function, it is certain that permanent damage is inflicted by this method. There is no justification for this procedure nowadays, and it should be cast out among forgotten things. Lengthening of the nerve by turning down a strand from the upper divided end, or the bridging of the gap by strands of catgut, are methods with nothing whatever to recommend and everything to discredit them.

Happily the resources of surgery are not at an end in all cases where union of divided nerves is impossible. Tendon transplantation, especially in the case of the musculo-spiral nerve, and the posterior interosseous, gives results which in point of function are almost as good as those which come from nerve suture, and in point of time are much quicker. It is chiefly in the musculo-spiral nerve that large gaps are found, a piece of the nerve having been blown completely away. In such cases tendon transplantation gives excellent and speedy results. When the posterior interosseous nerve is wounded it is not worth while attempting to suture the nerve. The results in such cases are slow, and not always perfect.

In those cases where the nerve is partly divided, strands of intact fibres still remaining, the severed fibres are united in the same careful way, and the normal strand of the nerve bent upon itself, so as to allow easy approximation of the cut portions of the nerve. In perhaps the majority of operations upon nerves there is no division of fibres, but a length of the nerve is embedded in dense fibrous tissue. These cases give most excellent results. The fibrous tissue which so intimately surrounds the nerve is dissected away little by little. The nerve when first freed is seen to be white and shrunken; but within a few minutes it expands and takes on its normal colour. I had several cases of this kind in the Boer war, and the results at this long interval are perfect. It is in these cases that advantage may sometimes be taken of the method of fat transplantation, or of nerve dislocation.

AFTER-TREATMENT.

1. Postural.

In cases where flexion of a joint has been necessary to allow approximation of the cut ends of nerves, the position is maintained for a period of six weeks. By this time union of the severed ends is probably well advanced. Extension by slow and most cautious degrees is then begun. If the knee has been flexed to allow the sciatic nerve to be united the patient can walk with a boot and leg irons, keeping the position unaltered for, say, two months. Wherever possible a splint is applied which produces a "relaxation position." In the case of the median and ulnar this is difficult, and is best secured by moulding a "ball splint" to the hand of the patient. Every such splint must be made for the individual. In the case of the musculo-spiral it is very simple. The "cock-up" splint designed by Colonel Sir Robert Jones is excellent, if the lesion of the nerve is below the branch to the supinators. It maintains hyperextension of the wrist, and, reaching only to the heads of the metacarpal bone, it allows a forward bend of the metacarpo-phalangeal articulations. The thumb lies forward and a little inwards, so that the position of the whole hand is very much that assumed when a bottle is grasped. If the lesion is above the nerve to the supinator brevis, it is essential that this muscle also should be relaxed. For this purpose Dr. Cuthbert Morton has devised a splint which retains the forearm and hand in supination while the wrist is fully extended, the fingers being at the same time kept in the bottle-grasping position.

Similarly, in cases of injury to the external popliteal nerve, relaxation of the corresponding muscles may be secured by the boot which has been introduced by Dr. Cuthbert Morton in order to allow the patient to walk about with the foot in permanent dorsiflexion.

2. Massage and Electrical Treatment.

These measures are restarted about two weeks after operation with all due precautions and safeguards. If a splint has been applied to secure the "relaxation position," it must not be removed. Indeed, not for one moment at any time must paralysed muscles be stretched. An over-stretching of a few minutes may call for diligent treatment of many weeks before the harm is undone. If a splint needs removal for purposes of cleanliness, the patient must be instructed beforehand to keep the limb in the exact position required. In the case of musculo-spiral palsies the hand drops into the correct position if the flexor surface of the forearm is upward.

RESULTS.

Our records are as yet necessarily incomplete. Recovery in the case of the musculo-spiral has begun within nine

weeks; in the case of the ulnar within three and a half months; in the case of the median in about four to five months. In one case of division of the inner cord of the brachial plexus recovery in all anaesthetic areas and a degree of recovery in all muscles occurred within five months. Recovery in the case of the sciatic nerve is slower. Something depends, it is sometimes said, upon the length of time elapsing between division of the nerve and its suture. My colleague, Captain Richardson, has, however, united the ends of an ulnar nerve cut across fifteen years before and signs of returning function were seen in about four months. The duration of the disability is, therefore, no bar to successful repair of the nerve.

The functions return usually in the following order:

1. Trophic and vasomotor function.
2. Deep sensibility.
3. Tactile discrimination and localization.
4. Motor power.
5. Cotton-wool sensation.

Perfect restoration of function has been most nearly approached in the case of the musculo-spiral nerve. In other nerves with more complex distribution perfect recovery will depend upon a recognition of the functional localization within the nerve trunk, in addition to the most scrupulous observance of all those technical details without which there will always be something less than perfection.

In the diagnosis and treatment of an organic lesion of a nerve it should never be forgotten that there may be superadded a functional disability. It is advisable at every stage to get rid of the functional in order properly to appreciate the organic. This is particularly important when the organic lesion is well on the way to recovery. Thus, in a recovering lesion of the inner cord of the brachial plexus it may be impossible for the fingers to be flexed until re-education has trained the laggard muscles into obeying orders from head quarters.

SUMMARY.

The following summary may be given of our experience up to the present time:

1. The earliest examination should be made of all wounds in which division of a nerve trunk is probable. If at the casualty clearing station such a lesion is found, end-to-end suture should be adopted forthwith. This is more likely to be possible in cases where primary suture of the wound, after excision, is found practicable.
2. If secondary sutures of the wounds, after the Carrel-Dakin method has been practised, is to be undertaken, the union of divided nerves should be secured at the same time.
3. If these methods have been attempted and have failed, they do not prejudice the later union of the nerve. On the contrary, they probably ensure that an easier and more satisfactory operation can then be practised.
4. Throughout the whole period before late nerve suture is attempted the strictest attention must be paid to the relaxation and nutrition of all paralysed muscles, to the maintenance of suppleness in all joints moved by these muscles, and to the preservation of the integrity of the skin.
5. Operations upon nerve trunks demand the most scrupulous observance of the ritual of asepsis. There must be the greatest gentleness of manipulation; the nerve must not be injured by instruments or by the surgeon's finger; it must not be separated from its sheath or disturbed overmuch from its bed; it must not be chilled or allowed to dry. All sutures must be of fine catgut, and introduced with most punctilious accuracy. Axial rotation of the nerve must be avoided. The cut ends of the nerve before approximation must show clearly the fibres of which the trunk consists.
6. Nerve-grafting is of little or no value; nerve anastomosis is to be sharply condemned; the turning down of flaps from the nerve to bridge a wide gap is useless.
7. Tendon transplantation is of great value in cases where nerve suture is impossible, or has given a result not entirely satisfactory.

REFERENCE.

¹ BRITISH MEDICAL JOURNAL, 1917, i. p. 117.