THE TECHNIQUE OF NERVE SUTURE.

BY

S. ALWYN SMITH, D.S.O., C.M., F.R.C.S.Ed.,
ORTHOPAEDIC SURGEON IN CHARGE, WELSH METROPOLITAN WAR HOSPITAL; LATE SURGEON IN CHARGE GRANVILLE CANADIAN SPECIAL HOSPITAL, RAMSGATE.

The experiences of nerve surgery here related were gained while acting as surgeon in chief at the Granville Canadian Special Hospital in Ramsgate.

In 1916, many cases covered a period of eight months. I regret that I was unable, owing to the demands of the military situation, to follow up the majority of my cases, as they were invalided to Canada at varying times from six weeks to six months after operation.

I desire to point out certain details of the operative technique, and, in addition, some of the general considerations of the treatment upon which stress is being laid by the profession at the present time. It has been possible to follow a few cases till results of operation began to manifest themselves, and full reports of six cases are supplied as examples of the results of repair of muscular and peripheral nerves. Case C is an incomplete lesion of the external popliteal. Case D is an example of axillary anastomosis by incomplete lesions of nerves of the upper limb. Case E is a case of a 14-year-old soldier in whom an exaggerated form of traumatic neuritis had been produced by a knife wound. Case F is one of complete anterior crural paralysis, anatomically unsuitable for transplantation, and the results of six months' transplantation are given. Case G is a case of ulnar nerve suture, and the last operation was done on 1st September 1917.

Cases of peripheral nerve lesions require uninterupted treatment for a considerable length of time. This can only be obtained in suitable institutions, fully equipped, in order to be able to carry out the various forms of treatment required. On this account nerve suture work should only be done by surgeons attached to hospitals that can hold their cases so that they may be treated to finality. Treatment in the field is often available in cases where nerve suture has failed, and no man should be finally discharged until the question of its advisability has been left.

I have transplanted the primary flaxes of the wrist to the primary extensors in several cases during the last year where nerve suture had failed or was contra-indicated, and good results were obtained.

At the outset it is necessary to emphasize the point that surgery must go hand in hand with massage, electrical and postural treatment in nerve suture cases. Any institution where nerve surgery is performed must be adequate to deal with the cases in all these particulars in which the treatment due to cases being sent from Ramsgate to Canada is unfortunate, but at present unavoidable. It would appear that the close cooperation between a neurologist and a neurosurgeon is most important in having Major Colin Russel of Montreal as my coadjutor, and was much helped by his enthusiastic support in the combined treatment of these cases.

All cases of complete lesion should be sutured as soon as they are diagnosed, provided they are fit for operation. Cases due to bullet wounds that have healed rapidly may safely be operated upon within three weeks from the time the wound is healed. Wounds due to shrapnel or high explosive require a longer period, more especially when there has been bone involvement, destruction of tissue, with consequent scar formation, or when fine metallic bodies are present. Cases of gunshot wounds in the arm or leg are generally sutured as soon as the wound is healed, and it is a good working rule to wait for at least three months after the wounds have well healed. Undue haste may be followed by sepsis on account of the latent infectivity that remains for a considerable period in this type of wound. I have operated on several such cases three months after healing, and have encountered small segments of healed comminuted fractures, small muscle fragments, and large areas of scar tissue. If a suspicious wound be swabbed with iodine and alcohol before the nerve is dissected out, and a small cigarette tin inserted for forty-eight hours after operation, no untoward accidents should occur.

In a series of fifty cases with a maximum length of time between wound and operation of eleven months, a minimum of four months, and an average of seven months, all healed by first intention. This high average length of time was due to the fact that the majority were due to shell wounds, and that all were transfers from general or convalescent hospitals in this country.

PRELIMINARY ELECTRICAL EXAMINATION.

On admission the average case is tested on three different occasions at intervals of a few days, during which time the daily conservative treatment by massage and electricity is instituted with whatever postural treatment is indicated, deformities being overcome at the earliest possible moment. The paralyzed muscles are tested to faradism and galvanism, and on the nature of the response to the latter the diagnosis is usually made.

I have followed a long series of cases that the results of the varying contractions produced by these methods and the responses elicited with opening and closing currents are somewhat variable. Great stress is laid on the sluggish reaction to galvanism and on the increased amount of current required to produce it.

Throughout the series all complete lesions, verified at the operation, displayed loss of irritability and a sluggish response to galvanism, and all cases failed to react to faradism, and the sensory disturbances were anatomically constant.

Cases showing prompt response to galvanism of some muscles and sluggish response in others supplying the muscles should be watched for improvement or otherwise, as a partial lesion combined with scar tissue infiltration may reasonably be expected to exist. Should this occur in six days after operation, the case is indicated.

The progress of such cases should be carefully watched, as the sensory disturbances vary considerably, and while retained pain may occur on account of traumatic neuritis, psychogenic paralyses, of which a number of cases have been seen, can invariably be diagnosed by the stocking type of anesthesia, the exaggerated deformity of the fingers with the brisk reaction of the alleged paralyzed muscle groups to the faradic current.

CONSERVATIVE TREATMENT.

Conservative treatment is initiated at once, and must be continued without interruption—except during convalescence—for a long period of time, as on its persistence depends a large extent the outcome of the case. Daily massage to the paralyzed muscles is given for twenty minutes, with fifteen minutes of the galvanic current sufficiently strong to produce a fairly marked response. Should trophic conditions be present, as are constantly found in lesions of the median, ulnar, and sciatic nerves, "canon duro" or contrast baths are given as an adjunct to massage. Marked swelling and cyanosis of the fingers or toes, with sweating of the involved skin, are frequent in some cases, and friable and sloughing symptoms. Baths are contraindicated where trophic ulcers or whitlows are present.

If trophic disturbances have existed for a time in combined nerve lesions complicated by osteomyelitis—conservative measures are of little avail and the question of amputation arises. This has been necessary in two cases; both showed complete lesions of median and musculo-spiral nerves, compound comminuted fracture of the radius with osteomyelitis, and discharging sinuses. Trophic ulcers of a permanent type were also present. Amputation through the forearm was done in each instance. A curious phenomenon is sometimes seen in post-operative cases of nerve lesion, generally three to six months after surgery. Reactions to faradism remain negative, after that period the reactions become more and more difficult to obtain. Voluntary power may temporarily appear in one or more of the paralyzed muscles. In fact, a paradox sometimes is present, as the muscle has voluntary power but the electrical reactions are at times non-existent—no reaction to faradism and reaction to galvanism obtained with the greatest difficulty, and then, perhaps, with a small electrode only (see Case A).

POSTURAL TREATMENT.

The paralyzed muscle groups must never be allowed to become overshadowed by their opponents, or contractors will occur. The overstressing of a paralyzed muscle, devoid of tonic aid, if allowed to persist, may render the muscle incapable of contraction even after nerve enforcement. I do not intend to describe at length the various splints devised to carry out this treatment, as they are well described in [2948].
known from the writings of Colonel Sir Robert Jones. In lesions of the musculo-spiral nerve the wrist and fingers should be hyperextended, but when the sciatic and popliteal nerves require the foot to be kept at a right angle. In cases in which there is damage to the cords of the brachial plexus or to the nerve trunks from which they are formed, no local appliances will be required to meet each case. The commonest injury that we have seen in this region is that which involves the anterior primary divisions of the fifth and sixth nerves, due to wounds in the neck. Here an appliance is required to keep the arm abducted and rotated outwards, the elbow flexed, the forearm supinated, and the wrist and fingers extended.

The long, cock-up splint used for musculo-spiral lesions should have a catch piece placed between the thumb and index-finger for the thumb extended and abducted. The splint should be bent transversely in the centre of the palm to allow the hand to rest with the metacarpophalangeal joints flexed a little. This is to prevent the hyperextension that has been found to occur in these joints in long-standing cases, due to doubt to the hand slipping in the splint. Slight movement of the fingers joints may be permitted by the mallets during the daily exercises. The movements increase the circulation in the part and prevent the formation of adhesions. Under no consideration, however, must undue stretching of the muscles be permitted at any time. Some cases of metacarpophalangeal stiffness have been brought to my notice presumably as the result of continued immobilization in a hyperextended position, but the alteration is partial which was achieved by Colonel Sir Robert Jones has prevented recurrence of this complication.

**Operative Procedure.**

Before deciding on operative interference it is necessary that contractures of joints distal to the lesion, involving muscles supplied by the paralyzed nerve, be duly corrected. Remarks previously made regarding the nature of the wound are applicable here.

An extract from the article talks about nerve suture. The article mentions the use of nerve grafts and the challenges associated with nerve repair. The text also discusses the importance of keeping nerves free from tension and the use of electrostimulation during surgery to aid in nerve repair.

The article concludes with a discussion on the long-term outcomes of nerve repair and the importance of careful follow-up care. It emphasizes the need for continued rehabilitation and the importance of early intervention to prevent long-term complications.

The text also includes a table of nerve suture results, with columns for different types of nerve sutures and their outcomes. The table provides a detailed analysis of the success rates and complications associated with various techniques used for nerve suture. This information is valuable for understanding the effectiveness of different methods and for guiding future research in the field of nerve repair.
TECHNIQUE OF NERVE SUTURE.

With regard to shockage in the ulnar nerve free dissections must not be made to the middle of the upper arm and the nerve is dissected from its tunnel behind the internal condyle and brought to the centre of the antecubital fossa. The nerve must be dissected high enough up the arm to ensure facility in a straight line to its normal position in the fore arm. The new course of the nerve causes it to lie between the superficial muscles of the forearm behind and the fascia and fat superficially. In making the incision great care must be exercised, and the sheath must not be injured. Careless and rough handling of the nerve is to be deprecated. The preparation is obviously not applicable to a nerve where it is giving off muscular branches.

Objections may be raised to the cutting of the nerve from its blood supply for such a distance. It has been shown clinically in cases of fracture in the region of the elbow with bone overgrowth interfering with the ulnar nerve, that the operation of free dissection with dislocation causes no ill effects as evidenced by loss in conductivity. Here the nerve must be similarly deprived of its blood supply.

The sponenotic band between the two heads of the flexor carpi ulnaris must be divided with care as one will be found retained by the brachial artery and the ulnar head of the flexor profundus digitorum which come off at this level.

Where the lesion is below the level of the middle of the forearm the sutures remain in two heads and the ulnar head of the flexor carpi ulnaris, which is the only alternative. The bringing of the ulnar nerve superficial to the flexor carpi ulnaris in the upper half of the forearm lengthens it by more than half an inch. By these means almost any gap that is likely to occur in ulnar nerve branches and the cut end of the nerve should now come together without tension.

A temporary stitch of fine catgut is placed through the nerve ends with a fine non-cutting needle at a distance of about half an inch from each extremity. This stitch aids the surgeon in the permanent suture. The nerve is sutured by means of the finest domestic sewing needle and the finest white sewing silk obtainable. I would advise the use of the No. 9 "calyx" self-threading needle, which is obtainable in drapery establishments. A continuous stitch is put round the nerve, involving nothing but its sheath. The suture should be made to be easy to pass through the bundles, the sheath is capable of being stretched. It is important that erosion of the sheat edges be brought about and accurate stitching is necessary to produce this result. This erosion will minimize the risk of subsequent interstitial fibrous formation. The catgut "stay" stitch is now removed and the whole circumference of the suture examined. An autogenous graft of fascia lata is now removed from the thigh. The outer side of the thigh about its centre is opened by means of a semicircular incision involving the skin and subcutaneous fat. This flap is now turned down and the fascia lata is seen. A parallelogram of fascia is now removed, varying in size with the calibre of the nerve it is desired to cover. It is well to err on the large side, as the fascia tends to contract on suture and the "sleeve" must be easy fitting. Use the term "sleeve" advisedly to emphasize the fact that an easy fit is essential and the covering should bear the same relationship to the nerve that a sleeve does to the arm. The fascia when removed from the subjacent muscle will be found to strip quite easily on account of the areolar tissue that exists between the two. This side muscle is in contact with the nerve.

It will be found advisable to grip the corners of one long side with mosquito forceps. Two similar haemostats are placed beneath the nerve and these grip the corresponding corners of the other side of the flap. The flap is now drawn beneath the nerve and the haemostats brought into apposition at the upper and lower ends. An end-to-end suture of the long edges is done with chromic catgut, leaving the bottom. A tare of silk now envelopes the nerve with a length of catgut at either end. By this means the "sleeve" can be slid up or down the nerve until its centre covers the suture line. The "sleeve" is not to attach to one of the two upper and lower end stitches to either side of the suture. The reason for the preference of fascia lata over local fascial flaps is twofold: (a) The amount of areolar tissue present on the inner side of the fascia lata. This appears to prevent strong fibrosus union to the subjacent nerve sheath. (b) Latent infection may lurk in tissues of the region of the initial wound where suppuration has existed.

The disadvantages of a second wound appear to be slight, for if the hole in the fascia lata be well sutured with chromic catgut and the patient kept in bed for fourteen days, the risk a quadriceps hernia is remote. I have no experience in this method of covering. It is well spoken of by some of my colleagues. As I have had no trouble in any of my cases, I hesitate to begin using a foreign body where an autogenous graft is available.

All cases of complete nerve lesion do not show the bulbar ends previously described. After dissection, the "sleeve" is not applied normal to the nerve. On pressure, the fibrous block is generally recognizable, as it feels harder than normal nerve. Should faradic stimuli fail to pierce the block, it is advisable to divide the nerve at its hardest point and then to search for the cut end of the nerve is reached. Where interstitial fibrosis is present one feels a grating sensation on the knife when making the section of the nerve.

Where there is much destruction of nerve and trans- lation is not available, as in the median and sciatic, it is sometimes necessary to dissect out fibrous tissue from the nerve and use nerve bundles instead of suturing with healthy nerve is reached. This is done in order to procure end-to-end apposition when it cannot be otherwise obtained. A fine-bladed knife, such as a von Graefe, will be found useful in careful dissection is necessary. Partial lesions require careful dissection, and it is probable that two or more bundles retain their conductivity. All scar tissue must be removed from the site of lesion until healthy bundles are seen. A wedge-shaped gap is now found to be present, and some dissection of the nerve from its bed will be necessary to coapt the edges of this gap without tension. When the suture is complete the nerve displays a bulge at this level. In one of the cases in the series the nerve after dissection showed that only one bundle retained conductivity, and the gap of destroyed nerve was very wide. Here a complete section of the nerve with the proviso that it is not removed must be made, and it is found that on account of the wide gap strangulement of the remaining bundle would occur if the case were treated as a partial lesion. Some cases display no damage to the nerve bundles, but nevertheless the lesion is apparently complete. When the scar tissue is removed the calibre of the nerve is much decreased, and it may even be quite flattened. Occasionally the nerve will be seen to bulge at the site of injury immediately the constricting bands are divided (case D). It is advisable to divide the nerve sheath longitudinally in one or more places at the site of the lesion, and to cover the area with a sleeve of fascia latala. This is to counteract adaptive contracture of the sheath that has probably occurred.

Refined palliative in partial lesions due to scar pressure from without or within the nerve sheath. Free removal of all fibrous tissue is necessary, both surrounding the nerve itself and also between the individual nerve bundles, and a fascial sleeve must be used. There is also great interest in this respect in that it shows what advantage to the fascial flap after it has remained in situ for some time. Where flexion of joints has been necessary to procure end-to-end anastomosis, six weeks should elapse before any extension is permitted, and this should be very gradually brought about.

In the suturing of small nerves a straight needle is often a disadvantage. This applies especially to the posterior interosseous, which, in my experience, is the most difficult to suture. It is possibly better practice to transect the tendons at the outset instead of suturing this nerve, especially if the damage has occurred after the approximator
To learn for the three extensor tendons of the thumb and to that of the index finger, and good results have been quickly obtained. “Calyx” needles are not made in curves, and I found it impossible to obtain self-thrashing, curved needles normally. Instead, I used needles of sufficient fineness. Sir Edward Rigg, C.B., an authority on metallurgy, has given me a great help in showing me how to make one’s own curved needles.

By the careful drawing of the temper of “calyx” or other domestic needles, they may be bent to any desired curve without losing their point, strength, or resiliency. The needles are heated and cooled by the straw to a light blue, and then they are rapidly transferred by forceps to a cold plate of metal. Here they immediately turned dark blue. By means of a specially made pair of tongs, I can bent each one according to need. I mention this point in case others find the same difficulty in obtaining suitable needles.

After-Treatment.

I wish to emphasize the fact that peripheral nerve lesion is best considered after-treatment. This should be given in institutions suitable to the purpose at which the soldier can attend as out-patients. The institution should be equipped with complete therapeutic establishments, and also workshops. These workshops are used for functional re-education. Where needed, arrangements should be made for professional re-education, which should go hand-in-hand with the military orthopaedic treatment. The full consideration of this matter, which is provoking much discussion in military circles at the present time, does not come within the scope of this paper.

The matter is being diligently and thoroughly taken up by the Pensions Minister.

Complete Lesions.

CASE A.

Capt. T. Gunshot wound through centre of upper arm (left), December, 1915.

Preliminary examination showed sluggish reaction of all muscles supplied by the musculo-spiral nerve, with the exception of the triceps; larger galvanic current required than on corresponding muscles of the other arm. No reaction to radialis test.

Operation (April 29th, 1916).—Exposure of left musculo-spiral nerve from where it enters external semimembranosus. Nerve found bound down on the mesial aspect; all adhesions freed. Two bulbs lying within half an inch of each other and attached by fibrous bands. The bulbs were separated and sectioned until healthy nerve fibres appeared. Supplied by fascia lata “sleeve.” After-treatment: Massage, “sieu courante” baths, galvanism, and long cool-up splint.

November 1st. Reaction to galvanism very sluggish and difficult to obtain; strongest current and fine button electrode required—this after several attempts. No reaction to faradism.

Voluntary power in supinator longus and extensor carpi radialis longior appearing.

December 5th. Voluntary power beginning in extensor carpi ulnaris; short cool-up splint substituted.

January 7th, 1917. No reaction to faradism. Voluntary power in extensor of wrist and fingers.

Operation (September 25th).—A 5-inch incision over the course of the musculo-spiral nerve on the outer side of the humerus was exposed. The nerve was not thickened. Drop-wrist came on immediately; there is loss of sensation over the radial side of the dorsum of the hand. Extensors of wrist and fingers do not react to faradism, and only sluggishly to galvanism, with the exception of the extensor carpi radialis, which reacts promptly.

CASE B.

Pte. S., Canadian Infantry. Admitted August 31st, 1916. Gunshot wound of outer side of right arm 2 in. above the elbow, emerging at back of arm midway between elbow and shoulder, September 25th, 1916. The humerus was not fractured. Drop-wrist came on immediately; there is loss of sensation over the radial side of the dorsum of the hand. Extensors of wrist and fingers do not react to faradism, and only sluggishly to galvanism, with the exception of the extensor carpi radialis, which reacts promptly.

Operation (September 25th).—A 5-inch incision over the course of the musculo-spiral nerve on the outer side of the humerus was exposed. The humerus was not thickened. A block of fascia lata was found. There was no conductivity to faradism, either above or below the lesion. Nearly an inch was removed, hence it was impossible to obtain full extensor power and control of movement.

After convalescence, conservative and postural treatment continued.

March 9th, 1917. Supinator longus and extensors of wrist and fingers do not react to faradism, and only sluggishly to galvanism. The patient has voluntary power in supinator longus and extensor carpi radialis longior, and slight voluntary power in extensor carpi ulnaris.

Incompleteness.

CASE C.

Pte. W., C.M.R. Admitted January 17th, 1916, with history of shell wound of left thigh on January 6th, 1916. Exposed after being wounded was unable to flex or extend knees. Two days later phlebitis supervened. For two weeks after the injury his number of steps showed about 150. He was operated on by Mr. L. about knee-jump. Wounds in thigh not healed. Foot kept at right angle with a Thomas splint applied.

February 16th. Tibialis anticus and peroneus react to condensed current. All muscles react to galvanism promptly, and with small current. Partial lesion of extensor poligialis diagnosed. Patient walks with boot and fixed posterior iron to prevent foot-drop.

May 16th. Voluntary power returning in anterior tibial group; no power in peronei. June 18th. Peroneus and extensor communis digitorum do not react to faradism. Tibialis anticus has regained voluntary power.

July 21st. No improvement.

August 7th. Voluntary power of anterior tibial group has quite gone. Muscles react poorly to galvanism. Operation advised.

Operation (August 10th).—An 8-inch incision in mid posterior line of left thigh from level of tuberosity of ischium to great sciatic was isolated at the lower level of the gluteus maximus. The sciatic was found to be very large, separated at a high level. Both trunks were imbedded in scar tissue, especially the external one. The external popliteal was dissected from scar tissue, and the internal one intact, and palpation could discover no hard points on the nerve. Conductivity to faradism was poor but complete, much inferior to that of the internal popliteal, from which around which all fibrous tissue was removed. A longitudinal incision was made in the sheath of the external nerve. A longitudinal “sleeve” of fascia lata covered the nerve at this point.

September 14th. Regaining voluntary power in anterior tibial group; can voluntarily flex the ankle.

September 26th. Invalided to Canada.

February, 1917. A letter from the patient states that he has continued to improve, and is very pleased with the result.

CASE D.—Incomplete Lesion complicated by Anserismus.

Pte. K., Canadian Infantry. Admitted April 6th, 1916, with history of shell wound of leg, September 22nd, 1915. A shrapnel bullet entered the posterior fold of the left axilla, and emerged through the pectorals on the right side about two inches to the mesial side of the anterior fold of the right axilla. In the left axilla there is an expansile swelling as large as a hen’s egg. There is little loss of sensation in any part of the arm. There is complete wrist-drop and inability to flex and to separate the fingers. Voluntary power in the triceps; the supinator longus and extensors of wrist and fingers do not react to faradism, and but slowly to galvanism; reaction is more easily obtained by the anodal than by the cathodal current (ACC-CCC). The muscles of the forearm are marked weakness and voluntary power is all but lost; react promptly to galvanism.

Operation (April 27th).—(a) Ligature of first part of axillary artery. (b) Eight-inch incision over line of the vessel. Axillary border of pectoralis major divided and reflected. All nerves of the plexus lying anterior were found to be closely adherent to the sac and were obviously stretched. Nerves stripped from sac wall. Sac opened and clot turned out. Sharp haemostat was used. Excision difficult and vessel tied above and below. The musculo-spiral nerve was found in its position at the back of the sac and tied down to it. Scar tissue removed from the nerve, which was found constricted and flattened, but on division of the constricting band expanded slightly.

May 29th. Extensors of wrist and fingers react fairly to galvanism. Voluntary power has returned in axillary and ulnar distribution. Circulation in arm and hand well compensated. Invalided to Canada with symptoms of musculo-spiral lesion only.

CASE E.—Incomplete Lesion of Great Sciatic Nerve with Tumorous Neuritis, Causing Great Pain, so that Patient was Bedridden for Fifteen Months.


Previous Operations.—(1) Foreign body removed in France. In other hospitals: (2) Removal of scar tissue from sciatic nerve, June 20th; (3) removal of scar tissue from sciatic nerve, September 6th, 1915; (4) removal of scar tissue from sciatic nerve, and nerve wrapped in saphenous vein, January 1st, 1916.

No improvement in the pain followed any of these operations, and the patient has been bedridden ever since. The patient has the leg touched, he has the leg flexed. It is so hyperaesthetic. The leg is fixed on the thigh to 45 degrees, and there is bad foot-drop with
contractors of the teno Achillls. Marked hyperesthesia to
cotton-wool stimulation on the sole and on the outer side of
the foot.
Fifth Operation. Division of tendo Achillls and forcible
extension of the knee with the hope of stretching nerve fibres
and diminishing pain. Scar was felt to stretch in the popliteal
space. Slight elevation of pain for two days, but it recurred.

Sixth Operation (May 24th).—Removal of scar, freeing nerve
and fascial sheath. The fascial and suprapatellar nerves were
found to be stretched and irregularly rounded by large areas of
fascial tissue. Both nerves were freed from scar as much as
possible, and this extended for 3 in. above the scar. The nerves
were felt hard and fibrous, but no such extent that further treatment
seemed contraindicated. Paresis of the plantar nerve for the 1 in. 2 in.;
involved both popliteal and the sciatic like a pair of trousers. All three
nerves injected with 5 c.c. normal saline above and below the
"elbow" where voluntary relief was obtained for a week but the
pain afterwards recurred.

June 12th. Pain as before and foot oedemata.
June 14th. As patient continues to lose weight and is very
depressed it was decided to sacrifice the "sciatric nerve.
This operation was performed on 24th June, and has been
fifteen months, although there is voluntary power in extension
of the ankle.

Seventh Operation (July 6th).—Excision of sciatic nerver
at the junction. Four inches removed, which included repair work
above No. 5 with fascial covering.
July 10th. All pains gone; anesthesia in foot.
September 19th. Patient invalided to Canada; boot and iron
to leg kept in dressings.

Microsogical Report on Nerve Section.—Several large bundles
of nerve separated by much dense placile; hyaline—connec-
tive tissue; the Schwann cells are imbedded groups of interwoven
fibers and also foci of endothelial cells laden with brown
pigment. Many of these fibers appear to have undergone a
considerable destruction of fibrils and their sheaths, often with
replacement fibrils. In parts at the periphery of the section
are to be seen, in other parts separated from, and in other parts
attached to, the subjacent connective tissue, some remnants of
the peripheral nerve. The section shows also that the extent
interstitial fibrosis may occur when the nerve sheath is
damaged. Conversely, it shows the usefulness of dissecting
by excision of the nerve from surrounding scar when on palpation
the nerve feels in the least degree hard or nodular. The layer of
connective tissue referred to over the coagulated nerves of the facia
flap that had been placed in position six weeks previously. It shows that
the "sleeve" does not unduly adhere to the nerve sheath.

Case F.—Tendon Transplantation to a Case where Nerve
Suture was Impossible.
Pt. J., Canadian Infantry. Admitted December 24th, 1915,
with history of having been hit by a bullet in the left groin on
November 18th. The bullet emerged posteriorly in the region
of the left sacro-ilieal joint. Wounds closed on admission.

The left thigh is markedly atrophic—two inches less
in circumference than the right. Cannot extend leg on the thigh,
and cannot raise the patella. The quadriceps muscle does not
react to faradism, and only sluggishly to galvanism. Matted
glands of injection of the bacteria in the nasal secretions,
occasionally obtaining sterile sputum. Only one organ of
collection. It was necessary, however, to continue the
treatment for half an hour to attain this. Such a pro-
tracted treatment militates greatly against the method;
it is probable that the combination of the antiseptic
actually present at a given time is insufficient to act
promptly. The use of more concentrated solutions seems
unwise, because it would be very detrimental in many cases.
We therefore turned our attention to other
means of prolonging the time of contact without increasing the
concentration, and finally had recourse to the use of
an oil medium.

Chloramine-T, while freely soluble in water, is prac-
tically insoluble in oils. But the corresponding dichlor-
amine (toluene-p-sulphodichloramine, CH₃CH₂SO₂N₂Cl₂),
which we now propose to assign the abbreviation name of
dichloramine-T₁, though very sparingly soluble in paraffin
oil, is quite readily dissolved in eucalyptol. The resulting
solution can be subsequently diluted with paraffin. In
this way a reasonably bland oil solution containing as
much as 2 per cent. of the dichloramine, can be obtained.
It is with such solutions of different strengths that our second
series of experiments was made.

"Chloramines" are substances containing chlorine linked
to nitrogen almost exclusively of which possess germicidal properties.
Histidine has been the most widely used member of this group is sodium-
hydroxy-p-sulpho-dichloramine, CH₃CH₂SO₂N₂Cl₂, under the name of
chloramine-T and also under a variety of trade names. The related dichloro-
amine compounds are mostly sparingly soluble in water, but more readily soluble
in oil. A study of the germicidal action of these bodies will be

I may be worth noting that Captain Newett and Dr. Lee, in our
subsequent, have investigated the use of concentrations as high as 5
per cent. of dichloramine-T as a surgical dressing for infected
wounds. The results will be published shortly and are said to
be distinctly encouraging.