REFRESHER COURSE FOR GENERAL PRACTITIONERS**LACERATIONS OF THE HAND**

BY

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Many lacerations of the hand require to be treated in hospital, and those who work outside the hospital service may feel that they have little to do with the treatment of these injuries. It is, however, the general practitioner or the industrial medical officer who is first consulted, and it is he who must decide which patients may safely remain under his care and which require more specialized treatment. This is no light responsibility, for upon his judgment may depend the future livelihood of the patient. The hand does not readily forgive errors in treatment. Skin loss which is allowed to heal slowly by granulations instead of being closed by plastic surgery will cause fibrosis and disabling skin contractures. Exposure of deep structures without the aid of modern theatre conditions may lead to severe reaction, oedema, and a stiff useless hand. Infection may complete the ruin. Fortunately it is also true that few other regions of the body are more responsive to careful and delicate work, and much can be accomplished by reconstructive surgery if the early management has been correct and rapid primary healing obtained.

Consistently good results depend upon a high standard of treatment from the time the accident occurs until the final stages of recovery, and the more each one of us knows of the general plan the better can we play our part when the need arises. If, therefore, much of the ground covered in this article is concerned with hospital care it is hoped that there may be something of interest and value for the general practitioner.

Diagnosis

A careful assessment of the hand should be made to determine the extent of the injury. Small wounds may be associated with important tendon or nerve division, and these complications may easily be overlooked unless suspected and investigated. The patient should not be the one to discover it later and inform his doctor. A diagnosis should be made by observing movements and sensation, and under no circumstances by groping about in the wound for the cut ends of tendons and nerves.

Mistakes can easily arise when assessing the significance of finger movements, owing to the complex arrangement of muscle actions.

The fingers are extended at the metacarpo-phalangeal joints by the extensor digitorum communis. Extension at the proximal and distal interphalangeal joints is by the intrinsic muscles—interossei and lumbricales—or by the extensor digitorum, depending upon the position of the metacarpo-phalangeal joint. When this joint is flexed more than 45 degrees, extension of the middle and distal phalanges is by the extensor digitorum, but when the flexion angle is less than 45 degrees, control of distal extension is taken over by the intrinsic muscles.

The interossei and lumbrical muscles are the prime flexors of the fingers at the metacarpo-phalangeal joints. The flexor digitorum sublimis flexes the proximal interphalangeal joints and the flexor digitorum profundus flexes the distal interphalangeal joints; they both also serve as weak subsidiary flexors of the metacarpo-phalangeal joints.

The interossei muscles abduct and adduct the fingers in relation to the middle finger. This movement can be simulated by the combined action of long extensor and flexor muscles, for as the fingers are extended they fan open, and as they flex the fan closes again. Interosseus function can, however, readily be determined

by the fact that they are the only muscles capable of moving the middle finger from side to side in the plane of the extended fingers.

The median and ulnar nerves as they approach the wrist pass within a quarter of an inch (6 mm.) of the skin surface. The digital nerves pass down the fingers even closer to the surface. It is not surprising that nerves of the hand are often injured, even when the surface laceration is deceptively small.

The median nerve passes deep to the transverse carpal ligament into the palm and divides into a lateral and medial part. The lateral division gives a branch to the thenar muscles, supplying the abductor pollicis brevis, opponens, and the superficial head of the flexor pollicis brevis, and then proceeds to form the digital nerves providing sensation to the thumb and radial side of the index finger. The medial division forms the digital nerves to the ulnar side of the index finger, both sides of the middle finger, and the radial side of the ring finger. The lumbrical muscles to the index and middle fingers are supplied by these digital branches of the median nerve.

The ulnar nerve passes anterior to the transverse carpal ligament to divide into superficial and deep branches. The superficial, or sensory, branch forms the digital nerves to the ulnar side of the ring finger and both sides of the little finger. The deep, or motor, branch supplies the hypothenar muscles, all the interossei muscles, the lumbricals to the ring and little fingers, and those muscles of the thenar eminence not supplied by the median nerve.

Variations in the nerve supply to the intrinsic muscles are not uncommon. Sensory nerve division results in loss of superficial and deep sensation, and in dryness of the skin due to lack of autonomic function. Motor nerve function can be readily tested in the hand. The action of the interossei will determine the integrity of the ulnar nerve. The median nerve is tested by observing the abductor pollicis brevis and the opponens pollicis; the abductor raises the thumb from the plane of the hand, the nail remaining at right-angles to the palm, whereas the opponens carries the thumb round to face the fingers, the thumb-nail becoming parallel to the plane of the hand.

Principles of Treatment

Lacerations involving severe skin loss and nerve, tendon, or bone damage should receive no treatment outside hospital other than a copious protective dressing and a compression bandage to control haemorrhage. The hand and forearm should be immobilized by a simple splint. It is very rarely necessary to use a tourniquet; indeed, any tourniquet, other than a pneumatic one, applied to the upper limb is so fraught with peril that I would be most hesitant to use it. Severe lacerations are surgical emergencies of the highest order, and there should be the least possible delay between injury and full surgical treatment. Anti-tetanic serum should be given, and in all extensive lacerations a short prophylactic course of penicillin is advisable.

General anaesthesia is the most suitable whenever extensive surgery is required. It is fortunate that these patients do not usually suffer from serious shock, for the operative time may well run into two or three hours.

Brachial block analgesia or regional block is of use at times in special cases; for minor injuries of the fingers digital nerve analgesia is convenient. Infiltration around the base of a digit will give effective analgesia, but on no account must a constricting agent such as adrenaline be used with the analgesic solution. Vascular constriction may be so complete and persistent that gangrene of the digit can follow.

The hand is washed thoroughly with a detergent, such as cetrimide or soap and water, while the wound is kept covered with a gauze pack. The skin is dried and then painted with a suitable antiseptic—there is none better than iodine in 90% alcohol. The wound itself is then washed thoroughly and repeatedly with a detergent which is not harmful to the tissues. Strong antiseptics do more harm to the living tissues than the good they may do by destroying a few organisms.

All severely damaged and devitalized tissue should be excised, as in all open wounds. Non-viable and badly crushed skin must be removed, even when this involves loss of large areas of skin, but it is unnecessary to make a formal removal of a thin strip of skin in every lacerated wound of the hand. A laceration caused by a sharp implement will need little if any skin edge removal, but when a tearing or crushing element has been present quite extensive areas of skin and deeper tissues may be devitalized and require removal. This type of injury needs special care, because of the risk of infection beginning in damaged tissue.

Remember that any wound, small or large, may readily become infected, and that contamination from careless handling or breathing upon the wound need not and should not occur. A sterile technique and a face-mask are necessary for all wound dressings.

Skin Loss

It is of the utmost importance to obtain skin cover, and in the primary treatment of a laceration bone, tendon, and nerve repair must take second place to the restoration of skin loss. Raw areas and slowly healing wounds lead to prolonged tissue reaction, oedema, and fibrosis, and thus to stiffening of the hand.

Many minor lacerations may be sutured without tension and rapid primary healing obtained, but lacerations with loss of skin may leave vital structures exposed when all possible closure by suture has been completed (Fig. 1). Unless these structures are covered, infection will follow and lead to much delay before reconstructive surgery can begin.

Loss of skin may be made good by free skin grafts and by flaps, local or distant. Free grafts of either partial or full thickness will take readily upon the vascular structures of the hand, and weeks of disability can be prevented by the simple procedure of covering raw areas with skin taken, for instance, from the same forearm. The graft is stitched carefully in place and covered with wide-mesh vaselined

FIG. 1.—Types of skin loss showing suitable methods of repair. A, Whole-thickness free graft. B, Partial- or whole-thickness free graft. C, Tendon exposed, local flap necessary. D, Avulsion of skin, subcutaneous tissue, and terminal part of thumb, distant pedicle flap necessary.

gauze and a well-applied pressure dressing. This method is particularly suitable for traumatic amputation of the finger-tips, for, even when the phalanx is divided, the exposed medullary bone will give sufficient blood supply for survival of the graft. The greatest danger to these grafts lies in the formation of a haematoma; if haemorrhage persists after wound toilet, despite sustained pressure, a simple dry dressing may be applied and the grafting performed 24 hours later.

Free grafts will not survive upon the surface of tendon or dense cortical bone, and local hand flaps should be used (Fig. 2), the new raw area thus created being covered by

FIG. 2.—Example of rotation flap to cover exposed tendon, bone, or joint.

free split-skin grafting. If the skin defect cannot be closed by local rotation or transposition flaps, a direct flap may be raised at a distant site. The hand is approximated to the upper chest, the abdomen, or the opposite forearm, and a flap pedicle raised and attached in one stage.

Nerve Division

Delayed nerve suture has certain advantages over immediate suture, and there is, therefore, no need to regard nerve division as a surgical emergency. The nerve ends are united by suture of the sheath with very fine stainless steel or tantalum wire, silk, or human hair. It is an operation requiring an adequate exposure in a bloodless field and extreme accuracy of craftsmanship. The results of a satisfactory technical performance can be very good.

In cases of multiple tendon and nerve division at the wrist level, where immediate operation is imperative for the tendon repair, it is helpful to place a single suture through the nerve ends to prevent retraction and shortening of the proximal part.

It should be appreciated that median sensory loss in the hand is more disabling than the motor paralysis; moreover, the latter can to some extent be overcome by suitable tendon transference or tendon grafting, but sensation can return only by nerve recovery. Extensive operations in the hand and forearm to free the main nerve trunks and close gaps between the nerve ends, if necessary by nerve grafts, are amply justified to make the hand "see" and feel again. The ulnar sensory loss is not so disabling as in the case of median paralysis, but the motor loss is much more so. Sensation can be restored by nerve repair up to about five years after injury, but 18 months to two years is about the limit for motor recovery because irreversible changes occur in the motor end-plates.

Tendon Division

Tendon suture or replacement by a free tendon graft can always be performed as a secondary procedure. Its success depends largely upon the general state of the hand and upon the experience of the surgeon. It is not difficult to suture tendons and restore continuity, but it is not always so certain that a sliding tendon and good function will be obtained. Nothing should be done during the initial treatment that may prejudice an already difficult task. Nevertheless, there are occasions when primary tendon suture leads to good results, and while it is not possible to discuss this problem at great length some general indications may be given (see Fig. 3).

Primary tendon repair may be considered if the following conditions are satisfied:

1. The wound has been caused by a reasonably clean and sharp implement; crush injuries may cause more extensive tissue necrosis than is apparent to the naked eye and render primary repair inadvisable. Wounds complicated by skin loss or bone and joint damage are unsuitable.

2. Treatment is instituted within approximately four hours of wounding, but clinical judgment may extend this arbitrary period.

3. Operative conditions are adequate and the correct instruments and suture materials available.

4. An atraumatic technique is employed.

When these conditions are satisfied primary suture may be employed for all extensor tendon divisions.

Primary suture may be used for division of the flexor profundus beyond the level of the sublimis insertion, the

FIG. 3.—Types of flexor tendon division showing suitable methods of repair. A, Primary suture is permissible if general conditions are suitable; otherwise suture skin only and perform tendon graft later. B, Unsuitable for primary suture; suture skin only and perform tendon graft later. C, Primary suture is permissible if general conditions are suitable; otherwise suture skin only and perform secondary suture, tendon transfer, or free graft later. D, Primary tendon suture is always advisable if conditions permit. Perform nerve suture later.

flexor pollicis longus in its distal part, and the tendons in the palm, and immediate repair is obligatory for divisions at the wrist level. It is not advisable to perform primary or secondary suture of tendon divisions between the distal palmar crease and the sublimis insertion, for replacement by a free tendon graft at a later stage gives more uniformly satisfactory results.

As in all surgery of the hand, fine instruments and a delicate technique in a bloodless field are essential requirements in tendon surgery. The suture material most commonly used is stainless steel wire in single strand, gauge 40, or the twisted form originating in

Sweden. The wire is attached to a small straight or curved cutting needle. Stainless steel wire causes less reaction than any other suture material and may remain in the tissues indefinitely without ill effect. Satisfactory haemostasis must be obtained before the wound is closed, as haematoma is one of the causes of deep fibrosis and stiffening of the hand. If adequate haemostasis is secured there is no need to use any form of wound drainage.

Bone and Joints

There is much to be said in favour of the present tendency to use internal fixation, whenever possible, for metacarpal and phalangeal fractures associated with severe lacerations. The need for difficult and restrictive external splintage is avoided, and more attention can be given to the careful repair by grafts or flaps of any accompanying skin loss. Also there is not the same risk of late loss of position requiring further manipulation and disturbance of the healing soft tissues.

Internal fixation may be achieved by the use of carefully fashioned intramedullary bone-pegs taken from the tibia, ileum, or ulna, or by transfixion of the fragments by fine Kirschner wires.

Amputations

The necessity to amputate digits does unhappily arise in cases of extensive lacerations, but it is better to err upon the side of conservative rather than radical surgery. It needs considerable experience to decide whether a severely damaged finger can be restored to usefulness or whether it will eventually become an embarrassment. In our desire to preserve all living tissue in the hand we must not lose our sense of proportion and insist upon preserving digits which cannot be of any use.

When several fingers or the thumb are injured it is wise always to be conservative, because even a part of a digit may be of value to the mutilated hand.

Splintage

After any injury, by accident or by surgery, the tissues must be allowed time to rest and recover. The hand is supported by a compression bandage composed of gauze waste, wool, and crêpe bandage carefully and deliberately applied to give even pressure. The tips of the digits are always left exposed for inspection.

In many instances this bandage will be sufficient splintage, but it is often helpful to apply a simple plaster cover to hold the wrist in slight dorsiflexion. The fingers and thumb, unless there is some special contrary reason, should always be in the position of rest, with the thumb in moderate opposition and the fingers semi-flexed.

The hand, after operation, should be supported in an elevated position for 24–48 hours to assist in the vascular drainage and in the avoidance of oedema.

Next Refresher Course Article.—"Rheumatic Fever," by Professor C. B. Perry.

BICENTENARY OF THE MANCHESTER ROYAL INFIRMARY

BY

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The Manchester Royal Infirmary first opened its doors on July 27, 1752, 200 years ago, in a little house in Garden Street, off Withy Grove, on the site now occupied by the Co-operative Wholesale Society's building. The house held 12 beds and was staffed by a matron, three physicians, three surgeons, and a secretary. It was called the Publick Infirmary. The government was placed in the hands of trustees. These were persons who had given to the hospital 20 guineas or upwards at one time or were subscribers of 2 guineas or upwards annually.

On the opening day one out-patient presented himself for treatment. A week later the number had increased to five. The first in-patient, a boy of 12 with ulcers on his legs, was admitted on August 3. The number of patients rapidly increased, so that by the middle of October the matron had to be provided with a nurse and a servant. In April, 1753, a room was set aside for an apothecary's shop. In this way began the dispensary, which proved to be a most important feature of the hospital. At the end of a year's work 75 persons had been admitted and 249 out-patients treated, at a total cost of a little more than £400.

At the start of the second year the adjoining house was taken over and equipped with 10 beds. More important was the decision to build a hospital elsewhere, on land now known as the Piccadilly site, situated in open country at the upper end of Market Street Lane. Plans were drawn up for the erection of a building to contain 80 beds for patients, "with proper convenience for nurses and servants and including a hot bath." This "New Infirmary" was brought into use in June, 1755, with 50 beds. The two houses in Garden Street had served their purpose for nearly three years, during which time 374 in-patients and 1,629 out-patients had been handled.