Minor and emergency surgery / by Walter T. Dannreuther.

MINOR AND EMERGENCY SURGERY

BY

WALTER T. DANNREUTHER, M. D.

SURGEON TO ST. ELIZABETH'S HOSPITAL AND TO ST. BARTHOLOMEW'S CLINIC, NEW YORK CITY; EX-HOUSE PHYSICIAN AND SURGEON, JERSEY CITY HOSPITAL, ETC.

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THIS BOOK IS DEDICATED

TO

the earnest and ambitious young physician who is devoting all his time to hospital work, and whose only reward is the knowledge and experience thus gained:

THE HOSPITAL INTERNE

PREFACE

MANY excellent books on minor surgery have been written but so far as the author is aware, none has been adapted exclusively to the needs of the hospital interne. Each of the following pages has been prepared expressly for the members of a resident staff: for the interne's guidance when acting independently; to assist the ambulance surgeon in emergencies, to simplify practical work for the junior and to aid the senior in some of his predicaments. If this little volume but serves this purpose, its object will haven been attained. However, as the general practitioner and even the specialist, as well as the surgeon, is so frequently called upon to cope with this class of emergencies, the author hopes that others may find some useful points in its perusal.

Many subdivisions and details of minor surgery have been purposely omitted, as it is not intended to rewrite all that can be found elsewhere. Also, it may seem that the special attention accorded some of the more oridnary conditions, usually considered elementary and unworthy of much thought by the medical student, is disproportionate to the comparatively small amount of space devoted to them in the average text-book. An effort has been made particularly to emphasize those points that are of great importance in practical work, but which are often apparently disregarded or ignored. To avoid

confusion and favor brevity, the treatment outlined is in most instances that which experience has proved to be the most satisfactory. Incidentally, this will account for the frequent mention of iodine as an antiseptic and germicide.* It is assumed that the reader possesses the average theoretical knowledge of the medical graduate, but has had little or no practical experience, and therefore the author has endeavored to make his statements as simple, clear and concise as possible.

Due acknowledgment is made for information derived from many sources; the standard medical journals and text-books have been freely consulted and the methods in vogue at the leading hospitals investigated. The author especially desires to express his thanks and indebtedness to his friends, Dr. Terry M. Townsend of New York and Dr. Frank D. Gray of Jersey City, for their careful consideration and criticism of the manuscript, to Miss Eleanora Fry for the painstaking and graphic illustrations, and to the publishers for their uniform kindness and courtesy.

WALTER T. DANNREUTHER.

NEW YORK CITY
October, 1911.

*"The Surgical Value of Iodine," Medical Record, January 25, 1908. "The Practical Value of Tincture of Iodine and Iodine Catgut in Major Surgery," Medical Record, January 16, 1909.

CONTENTS

MINOR AND EMERGENCY SURGERY.

INTRODUCTION.

Having attained the coveted degree of M. D., the majority of recent graduates seek an appointment on the resident staff of some hospital. The term of service may vary from one to three years, usually averaging eighteen months, and the experience and knowledge gained during this time will prove to be of inestimable benefit and of the utmost importance throughout the young physician's subsequent professional life. Although he is afforded the opportunity of doing a certain amount of dispensary work in connection with the modern college course, the comparatively few real emergencies presenting and the student's subordinate position greatly minimize the benefits which apparently might be derived therefrom. It is while serving as a member of a house staff enjoying an active service that there is almost unlimited opportunity of applying the principles and teachings of the college course. Here too are encouraged and developed those qualifications so essential to success in practice: acuity of perception, dexterity and self-reliance.

The first few months of the hospital service are usually devoted, as they properly should be, to

laboratory work, history taking, applying ward dressings under the direction of the house surgeon, and the like. This gives the junior an opportunity to feel at home in his new surroundings, to acquaint himself with the routine of the institution and its personnel and to observe more or less emergency work attended by his superiors before assuming any responsibilities himself.

The interne should ever respect and obey the advice and instructions of the members of the visiting staff and any criticism that he has to make of their suggestions should be entirely mental. Discussions in private, however, concerning the diagnosis and management of cases are to be encouraged. The interne should keep his eyes and ears open and his mouth shut when in the wards. "Errare est humanum" and even the visiting surgeons may make mistakes occasionally, but, as Dr. Brickner has so aptly said, they probably have better reasons for being wrong than the interne has for being right.

Each member of the house staff should do his share toward the maintenance of a harmonious atmosphere among his fellows: routine duties being performed willingly and cheerfully and favors exchanged whenever possible. Mutual kindness, courtesy and loyalty will promote good feeling and make the day's work more pleasant.

The interne should never forget his dignity in the presence of nurses and orderlies. They should be shown every consideration but allowed no liberties or undue familiarity. Regardless of the apparent provocation, subordinates should never be criticised or corrected except in private.

CHAPTER I.

THE AMBULANCE SURGEON.

It is a grave error to permit a "green" interne to do ambulance work immediately, and many cities have recognized this fact by adopting an ordinance requiring at least six months' service on the resident staff before undertaking the duties of an ambulance surgeon. He should at least transfer a few elective cases to and from the hospital before answering any emergency calls, thereby accustoming himself to the presence of a crowd. Thus he will gradually acquire self-confidence and become impervious to the remarks and audible criticisms of the by-standers. An ambulance surgeon is at first likely to appear arrogant and disagreeable, or nervous and undecided, faults which should be studiously overcome. Collective gentleness, courtesy and firmness will win respect and inspire confidence. The public is quick to recognize the surgeon's attitude and will usually behave accordingly. He should never forget that he is a gentleman as well as a physician and should conduct himself as both.

The patient should always be moved as carefully as possible, his home respected, be it palatial or humble, and his relatives and friends shown every consideration. The danger of handling a patient roughly cannot be too strongly emphasized, no

matter how unimportant it may seem at the time. For example, in transferring a case of appendicitis, a sudden jar may rupture an existing abscess, ultimately resulting in a fatal issue.

Occasional difficulty will be experienced in transporting the stretcher downstairs, because of acute angles in the stairway. Under such circumstances it is better to either carry the patient down bodily, or seat him in a chair and carry the chair down. He should always be carried feet first down stairs, and *vice versa*. The greater part of the actual work may be safely left to the driver, policemen present and by-standers, under the supervision of the surgeon. It is not, however, correct or considerate to expect or demand the assistance of members of the patient's family. It is well to see that the patient is completely covered with blankets; and covering the face with a handkerchief while placing the stretcher in the ambulance is a trifling attention that will be greatly appreciated.

The following hints are worth remembering:

Don't lose your nerve; keep cool.

Don't lose your temper under any circumstances. Rather submit to insult than to lower your dignity by arguing or fighting with anyone. Call on the police for aid when you need it.

Don't forget that the patient is the only matter of importance that concerns you and that he requires all your attention.

Don't discuss your actions with by-standers. Decide quickly what you intend to do and do it unhesitatingly.

Don't refuse to take any unconscious person to the hospital, even though you are sure he is only intoxicated. It is better to have fifty "drunks" in the hospital each night than to have one die of an unsuspected fractured skull in the police station.

Don't forget that the appearance of a new ambulance surgeon is always productive of a great deal of malingering on the part of some of the inhabitants of the neighborhood.

Don't do on the street that which can be done at the hospital.

Don't "play to the galleries." Act quickly, quietly and decisively, but do all that is absolutely necessary and return to the hospital as soon as possible.

Don't make an intimate of your driver. A friendly spirit is commendable but anything more than that lowers your profession in his eyes.

Don't stop to talk to acquaintances on the street. You are a public servant while on duty and there may be another call awaiting you on your return to the hospital.

Don't allow your driver to drive recklessly; it jeopardizes too many lives. Always get to the scene of an accident as soon as possible and then adapt the speed of the ambulance to the needs of the patient.

Don't permit the driver to ring his gong unnecessarily.

Don't invite your friends to ride on the ambulance. It is not a pleasure vehicle.

Don't forget that you cannot take anyone to the hospital against his will or, if the patient is uncon-

scious and relatives are present, without their consent. If you are requested to take the patient home or to another institution, and the distance is within reason, do it cheerfully.

Don't fail to respect a patient's religion, especially if he is a Catholic; a priest should always be permitted to administer the last rites.

Don't forget to report in person to the house surgeon at once if you have admitted a grave case to the hospital.

Don't forget to change the linen on the stretcher after each call.

Don't forget to replenish the appliances carried in the ambulance and the ambulance bag after each call.

Don't forget that you have assumed great responsibilities and that human life often depends upon your judgment and actions.

If these suggestions are faithfully followed, they will aid the ambulance surgeon in contributing his share to the efficiency of the service and thereby reflect credit upon the institution.

CHAPTER II.

ACCIDENTAL WOUNDS.

Classification of Wounds:

1. Contused
   - a. without external communication.
   - b. with external communication.
2. Lacerated
   - a. localized.
   - b. extensive: avulsion of a limb or the scalp.
3. Incised
   - a. simple.
   - b. complicated: underlying important structures severed.
4. Punctured
   - a. penetrating.
   - b. perforating.
5. Poisoned
   - a. pyogenic infections.
   - b. tetanic infections.
   - c. venom infections.
   - d. rabid infections.
   - e. chemical infections.
6. Gunshot
   - a. blank cartridge
     1. powder grains.
     2. wadding.
   - b. bullet.

Wounds are designated and classified according to the nature of the causative trauma and the character of the injury. It is well to remember that notwithstanding the apparent localization of a wound in the beginning, sloughing of the skin and soft parts may ensue at any time within ten days as the result of extensive contusion, no evidence of which presented at the first examination. This is equally true of fractures, dislocations, etc. For

instance, in crushing injuries the skin wound may appear insignificant, yet areas of the soft parts may be extensively pulpified. If any blood-vessels of large caliber have been ruptured, gangrene may result in consequence of the impaired vitality of the tissues; the prognosis therefore should always be guarded. Free external bleeding or subcutaneous hemorrhage usually accompanies all wounds and the presence of more or less foreign material is to be expected. It will often be difficult to arrive immediately at a definite conclusion regarding the exact nature and extent of the injury, especially when dealing with contusions, owing to the accompanying swelling. In such cases it is better to err on the safe side and assume the presence of a more severe injury than to ignore its possibility. Any wound may produce shock in direct proportion to its severity and extent.

Examination of Wounds.—A careful examination of every wound and a thorough understanding of the existing pathology is absolutely necessary in order that remedial measures may be instituted intelligently. This, however, does not mean to "examine" a wound by probing it with a dirty finger, for little knowledge will be derived in this manner and additional infection may be introduced. Under exceptional circumstances only, as when the presence of a foreign body deep in the wound is suspected, is sterile instrumental probing permissible. It is unnecessary and inhuman to insist upon probing a wound simply to satisfy curiosity as to its extent, as the possibility always exists of again exciting

hemorrhage which has been arrested by natural processes, such as coagulation of the blood or torsion or retraction of the blood-vessels. Even when dealing with bullet wounds, probing is of little value in locating the bullet unless very near the surface, because of the free extravasation of blood into the muscles and other soft tissues separating the fibers and creating numerous false passages. Radiography, on the contrary, is extremely useful for the determination of the exact location of a foreign body. The possibility of a concomitant fracture at the site of the wound, or in head injuries at the base or on the opposite side of the skull, should be constantly borne in mind, even though there is no distinct evidence of fracture. Here again the *x*-ray will be a valuable aid. Enlarging the wound slightly, or freely if necessary, will often greatly facilitate inspection. The following features of wounds should be determined in order:

1. Extent of injury.
2. Accompanying fracture.
3. Integrity of the soft structures: periosteum, muscles, tendons and nerves.
4. Foreign material present.
5. Source of hemorrhage.

Treatment of Wounds.—The cardinal principle of the treatment of wounds is to bring about union by first intention if possible. In many instances such an immediately favorable result is obviously out of the question, and every effort should then be made to secure rapid granulation from the bottom. Upon the surgeon's judgment will depend whether a wound

shall be entirely closed or drained primarily. When in doubt, wounds opening into a cavity should be drained; in others an attempt may be made to obtain primary union. If closure without drainage is afterward proved to be an error of judgment, it is easily remedied by partial re-opening and drainage. In general, the treatment of wounds consists of:

1. Arrest of hemorrhage.
2. Shaving and cleansing with green soap of the surrounding skin.
3. Irrigation of the wound with hydrogen peroxide.
4. Removal of all extraneous matter.
5. Suture of divided important structures.
6. Institution of drainage, if required.
7. Coaptation of the edges.
8. Injection of tincture of iodine into the wound.
9. Application of a wet gauze dressing and bandage.
10. Putting the injured part at rest.

Fortunately there are many efficient methods of arresting hemorrhage at our disposal. In the majority of instances the simple pressure of a wet dressing is sufficient to control it. If a bleeding vessel has been wounded but not entirely severed, the division should be completed to permit retraction. When a single artery continues to spurt, it should be seized with a hemostatic clamp, but care should be taken that the jaws grasp the vessel only and do not include any adjacent tissue. It may then be subsequently ligated with catgut, if necessary. In severe injuries with considerable

arterial hemorrhage the tourniquet is of inestimable value and should be applied as near to the injured region as is consistent, in order to devitalize as little healthy tissue as possible. If a rubber tube or strap is not at hand, a tourniquet may be improvised by twisting a stick in a knotted rope or strip of linen. The use of the tourniquet should be avoided in patients with atheromatous arteries. Plugging a wound of the chest with cotton will effectually control hemorrhage from an intercostal artery. The actual cautery is rarely required to stop hemorrhage from a wound, except in the presence of persistent oozing, as in injuries of the liver or spleen. Styptics are useless in the treatment of surgical hemorrhage, for what little benefit is to be derived from their employment is of no consequence in comparison to the efficiency of other methods and, moreover, they are detrimental to subsequent wound healing. In superficial bleeding, however, topical applications of adrenalin chloride or beech-wood creosote control the hemorrhage very satisfactorily.

Shaving of the surrounding skin is not always requisite, but thorough cleansing with green soap is without exception of great importance. This should be done with a nail brush, if the condition of the skin will admit; but if bruised, a sterile gauze sponge is preferable because the brush may irritate the already tender skin and be a source of additional trauma. It is ridiculous to put clean gauze on dirty skin, and the area shaved and cleansed should always extend beyond the limit of the dressing.

Irrigation of a wound with hydrogen peroxide

serves to loosen bacteria, coagulated blood, dirt and foreign bodies. Although peroxide is an efficient deodorizer and cleansing agent, its germicidal powder is feeble. It may therefore be omitted when dealing with an apparently clean wound.

The variety of foreign bodies found in wounds is almost unlimited and we should be on the lookout for anything from a bacterium to a limb of a tree. It is important that a wound be first freed of all accumulated blood clots. As a rule, the greater part of the extraneous material may be removed by irrigation and the fingers, but if these prove unsuccessful recourse may be had to the knife, forceps or curette. Care should be exercised that the efforts to dislodge the foreign bodies do not push them in further. The wound may be sufficiently enlarged to facilitate removal. When instrumentation is necessary, the forceps or curette should be inserted *under* the foreign body, so that it may be lifted rather than pulled out. Bits of iron or steel are often easily extracted by means of a powerful magnet.

If muscles, nerves or strong bands of fascia have been divided they should be sutured. The two ends of the same structure must be positively identified and accurately approximated. The suture material selected for this purpose will depend upon individual preference, but for subcutaneous work it should always be absorbable. Plain catgut, chromic catgut, kangaroo tendon and iodine catgut[1] are most often

[1] Preparation of iodine catgut—the raw strands of appropriate sizes are immersed in a watery solution of 1 per cent. iodine crystals and 1 per

used, and of these iodine catgut is the most satisfactory. It is antiseptic and aseptic, impossible to infect (proved by bacteriological experiments) and its tensile strength and pliability are all that may be desired. It is easily prepared, thoroughly reliable and trivial in cost. It may be used to equal advantage in all manners in which a suture or ligature is ever applied.

Occasionally the edges of a wound, especially those of the lacerated class, may be very irregular. They should be trimmed with scissors, all tags being removed to obviate subsequent sloughing and to secure good coaptation, thus minimizing scar tissue formation.

Wounds where the chances of obtaining primary union seem to be good are best closed with a subcuticular suture of iodine catgut. It should be introduced in the same way as one of any other material; but the upper end is tied, the skin pushed up on the suture and the lower end tied, thus markedly decreasing the length of the wound (Fig. 1). The subcuticular suture obviates the necessity of suture removal later on. If the nature of the wound is such that it seems doubtful or improbable that union by first intention can be brought about, it should be entirely or partially closed with interrupted sutures, avoiding undue tension. Accurate approximation of the skin margins is essential, but constriction causes sloughing. The knots should always be tied well to one side and not directly over the line of union (Fig.

cent. potassium iodide crystals, allowed to remain for eight days and then transferred to a dry sterile jar covered with sterile gauze.

2); otherwise they may become entangled in the healing process and tend to re-open the wound when removed. The contra-indications for the use of iodine

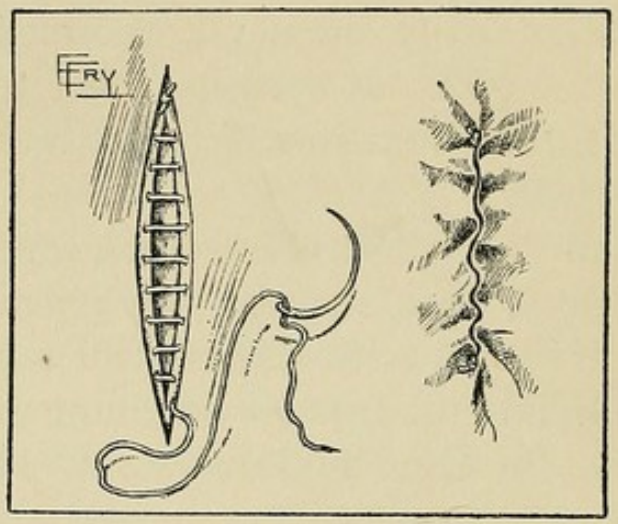


FIG. 1.—Subcuticular suture introduced and tied.

catgut are the probability of prolonged sloughing and great strain on the sutures, because the gradual ab-

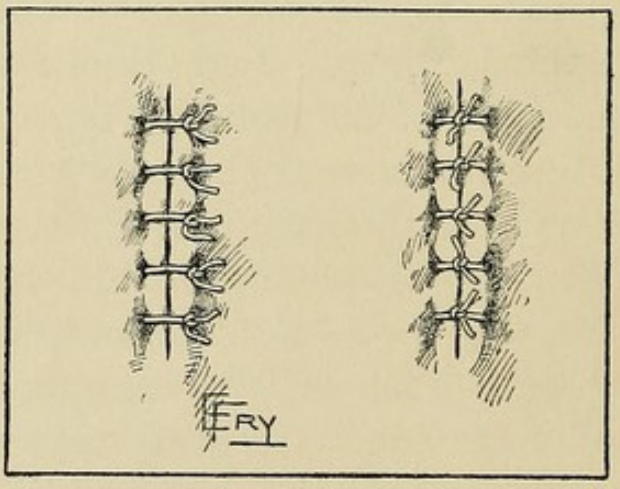


FIG. 2.—*a*, Correct and *b* incorrect method of tying sutures.

sorption of the sutures weakens their support. It is then prudent to re-inforce or replace them with through-and-through silk or silkworm-gut sutures.

Wounds of the lips, tongue and eyelids are best closed with fine black silk, because of the cosmetic effect.

Extensive wounds or those accompanied by severe contusion in which more or less sloughing seems likely to ensue should be drained. The most satisfactory material for this purpose is rubber tubing, except in small wounds which may be drained by introducing a little roll of gutta-percha tissue. Naturally, drainage should always be encouraged toward the most dependent portion of the injured area. Position, then, is an important factor. Plain sterile or medicated gauze, particularly that impregnated with iodoform, has been widely employed for drainage, but careful observation will demonstrate that gauze performs the function of a cork rather than of a drain. It will rapidly absorb serum or pus until it is saturated but will not promote drainage beyond that point. For packing clean cavities, however, plain gauze strips will be found exceedingly useful.

The best method of sterilizing a dirty wound is to inject tincture of iodine directly into it with an ordinary medicine dropper, previous to tying the sutures in the skin. Iodine is an agent of high germicidal potency, endowed with remarkable penetrating power and one of the most satisfactory and reliable antiseptics at our command. Even when sloughing is imminent, the iodine will hasten separation of the slough, limit the formation of pus, and stimulate granulation.

The primary dressing of all wounds should consist of several layers of sterile gauze saturated with a liquid: water, solution of aluminum acetate, equal

parts of alcohol and witch hazel, etc. They are best used lukewarm, as the continuous application of extreme cold depresses the vitality of the parts. Bichloride of mercury solutions have been more or less universally employed for this purpose, but they are inferior to others because they may excite a dermatitis and may injure the surgeon's hands after prolonged use. Contrary to the belief of many, the bichloride does not entirely destroy the bacteria but only coagulates the albumen of the capsule. Far better results will be obtained from the use of the above-mentioned agents, especially if used in conjunction with iodine. The popular "carbolic wash" should never be used for a wet dressing, as the solution itself is extremely poisonous and carbolic gangrene often follows. A wet dressing should always be bandaged with gauze so that the whole may be moistened from time to time. Glycerine is a valuable aid in keeping the dressings wet, since its powerful hygroscopic powers promote drainage and hasten sloughing. The practice of covering gauze compresses with gutta-percha tissue and bandaging with muslin is unsatisfactory, because the moisture will evaporate in spite of these precautions and then the dressing cannot be soaked again without removal.

Although a great deal may be learned from the text-book illustrations, bandaging is an art that can be mastered by constant practice only. Observation of the following general principles will prove useful:

Always "fix" the bandage at the start.

Avoid wrinkles and creases as much as possible.

Be careful that the bandage fits smoothly and snugly, yet does not constrict.

Always bandage from below upward; toward the trunk.

Remember that a bandage that does not commence at the fingers or toes tends to produce edema of the uncovered part.

Never bury the end of a bandage applied to the head, but leave it free so that it may be tied to the other end.

A bandage that requires pins or adhesive plaster to maintain its position has not been properly applied.

Split or cut the free end of a bandage longitudinally, tie a knot in it and this leaves two ends to tie together.

Rest of the injured area, for self-evident reasons, is of great importance, since motion and friction disturb the continuous apposition of the wound surfaces. Cases of severe wounds should be confined to bed, particularly if accompanied by shock. Usually the limited motion of the part occasioned by the dressing is sufficient, although frequently a splint will prove a valuable adjunct. When a joint has been injured, the limb should be immobilized in the position that will be most useful to the patient in event of permanent stiffness.

Emergency treatment of wounds should consist of those measures only that are absolutely essential for the maintenance of favorable conditions, and the permanent dressing should be deferred until

the procedures can be continued under rigid aseptic circumstances. The arrest of hemorrhage, prevention of swelling, removal of foreign material (provided it can be done quickly), exclusion of additional foreign material and control of shock are all that require immediate attention. The first may be obtained by a clamp, tourniquet or the pressure of the dressing; the second and fourth by the moist gauze and the fifth by the usual remedial agents for shock. Wounds of the abdomen from which a loop of the intestine or the omentum protrudes should be covered with gauze wrung out in hot saline solution, and no effort to replace it immediately should be made.

Passive hyperemia, after the method devised by Bier, will often prove a useful adjunct in the treatment of wounds, especially in those that have become infected. It is best induced by several superimposed layers of an Esmarch or Martin rubber bandage. The constrictor should always be applied proximally over the healthy tissue, should never give rise to paresthesia or pain, and the pulse should be perceptible below the constriction. Dressings must be temporarily removed from the wound and be replaced by loose sterile gauze, to permit hyperemia. For further details and technic the reader is referred to works on the subject.

After-treatment of Wounds.—Equal care in all aseptic and antiseptic precautions should be exercised throughout the after-treatment as when applying the primary dressing. The surgeon's hands, instruments and dressings should be sterile. A

simple and efficient technic of hand sterilization consists of energetic scrubbing with green soap, followed by immersion in a watery solution of iodine; a dram of the tincture to a pint of hot water. The staining of the skin is inconsiderable and even its prolonged use does not injure the hands in the slightest. Iodine must not be used for the repeated sterilization of steel instruments, because of its tarnishing action. They are satisfactorily sterilized by boiling in a 1 per cent. solution of carbonate of soda. The gauze compresses, bandages, etc., should, of course, be previously sterilized by compressed steam. All dressings should be kept wet for at least three days. If there are then no evidences of sloughing or pus formation, dry sterile gauze is all that will be required. A neat dressing for small clean wounds consists of little sterile cotton painted and fastened down with collodion, but, as it does not provide for the absorption of wound secretion, it should be used only in clean cases in which hemostasis has been exact. The appearance of heat, redness and swelling denotes pus formation and is indication for the immediate removal of one or more sutures and the institution of drainage. The body temperature is also a reliable index of the condition of the wound. Tincture of iodine should be dropped along the line of union, and under it if the wound is being drained, at each dressing. If the granulating process is sluggish, sprinkling the surface with powdered naphthalin crystals and applications of balsam of Peru will hasten it. When healing is markedly retarded without some apparent cause, it is often due to diabetes.

The many dusting powders on the market are of little practical value; they are expensive, but feebly antiseptic and make a paste with the serum that exudes from the wound, thus causing the gauze to adhere to the line of union. Rarely, if ever, will a dusting powder destroy pyogenic organisms and prevent pus formation. Iodoform has been extensively employed as a dusting powder and incorporated in gauze, although it possesses but few of the virtues of the tincture of iodine. It liberates but a minute quantity of iodine, its odor is disagreeable and iodism frequently follows its use.

Contused wounds are the most common of all wounds encountered in surgical practice. They are accompanied by more or less pain, swelling and discoloration of the skin. Although they may appear insignificant at first, sloughing of the soft parts may subsequently occur, even though the skin is not visibly broken. This may be due to hematogenous infection or occur externally through a minute fissure in the skin. It should not be forgotten that sloughing may extend into a large blood-vessel and give rise to secondary hemorrhage. A hematoma usually forms, which eventually terminates in either absorption or purulent resolution. Diligent search should always be made for fracture of underlying bones. The appearance of a contused wound of the scalp is often misleading, because of the circumscribed swelling with a central depression, known as "Pott's puffy tumor." Should accompanying symptoms of cerebral concussion exist, the condition may closely resemble fracture of the skull, and manifestly

the reverse is true. Contused wounds of the abdomen should be kept under close observation for at least a week, for if severe they nearly always show shock early and internal hemorrhage or rupture of a viscus may occur at any time. The apparent absence of damage to the skin does not necessarily exclude internal injury. Rupture of a solid viscus or of the omentum generally results in internal hemorrhage; perforation of a hollow viscus is invariably followed by peritonitis. Likewise, a blow may produce submucous hemorrhage and subsequently ulcer of the stomach or intestine. Increasing rapidity of the pulse is characteristic of rupture and no patient should be considered out of danger if the pulse is rapid. When injury to the bladder or urethra is suspected, the gentle passing of a soft-rubber catheter will help to clear up the diagnosis. A contusion may cause a bursitis, arthritis, periostitis or osteomyelitis. A tubercular process is particularly likely to be excited by a contusion, especially in a joint.

Contused wounds should be dressed immediately with gauze saturated with water, aluminum acetate solution or lead and opium wash. This will tend to prevent swelling, limit subcutaneous oozing, allay pain, favor drainage and promote absorption of the effusion. An ice bag should be applied to severe contusions about the head, especially if accompanied by concussion. When sound teeth are knocked out, they should be replaced in their sockets, as re-attachment is often possible. Proper position may be maintained by fastening them to adjacent teeth with silver wire or silk. The accumulation of blood

under the nail following a contusion is often extremely painful; the cuticle overlapping the base of the nail should be gently lifted with a sharp knife and the blood squeezed out. A bursitis or synovitis with effusion of serum or synovial fluid should be aspirated under rigid aseptic precautions.

The slightest sign of pus under the skin after a contusion warrants incision at once. If the sloughing is at all extensive, counter-openings should be made by introducing a long dressing forceps closed and incising the skin which is made prominent by the tip. One or more fenestrated rubber drainage tubes of convenient size may then be inserted by opening the jaws of the forceps, grasping one end of the tube and withdrawing the forceps. Proper position may be maintained by fastening each end with a sterile safety pin. The incisions should always be made parallel to the course of the blood-vessels, and never at right angles (Fig. 3). The extent of drainage will depend upon the amount of sloughing, and the length of the tubes may be diminished as desired. The necrotic tissue should be excised at each dressing and the wound irrigated through the drainage tubes by means of a fountain syringe or a Valentine irrigator with peroxide, followed by an iodine solution: a dram of the tincture to a pint of water. A Davidson syringe should not be used because the pressure exerted cannot be accurately gauged. The appearance of bleeding denotes the cessation of necrosis and the beginning of granulation. These wounds necessarily close from below upward, so care should be taken that the skin margins do not close primarily and thus obstruct

drainage. Dead skin should be scraped off with a dull knife or gauze saturated with alcohol. Destruction of the arterial supply with necrosis of bone indicates amputation. The surgeon should be constantly on the alert for intra-abdominal complications following contused wounds of the abdomen. Con-

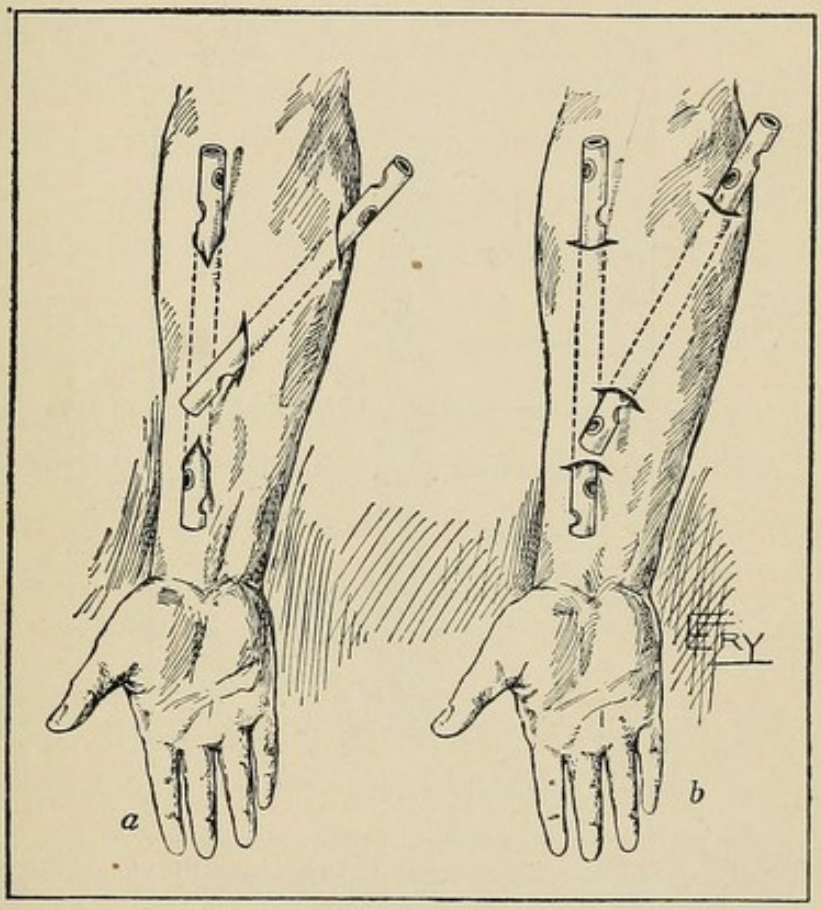


FIG. 3.—*a*, Incisions for drainage tubes made correctly; *b*, incisions for drainage tubes made incorrectly.

cealed hemorrhage or perforation of a viscus necessitates immediate abdominal section, unless the patient is moribund.

Lacerated wounds are due to semi-sharp traumatism or to a tearing force. Avulsion of a portion of a limb or complete tearing off of the scalp may oc-

cur as the result of machinery and railroad accidents, but fortunately such extensive lacerations are exceptional. The usual picture presenting is a long jagged wound, bleeding freely and contaminated by hair, dirt and other foreign material. They should be especially examined for severed tendons. A fissure fracture of the skull should be searched for in

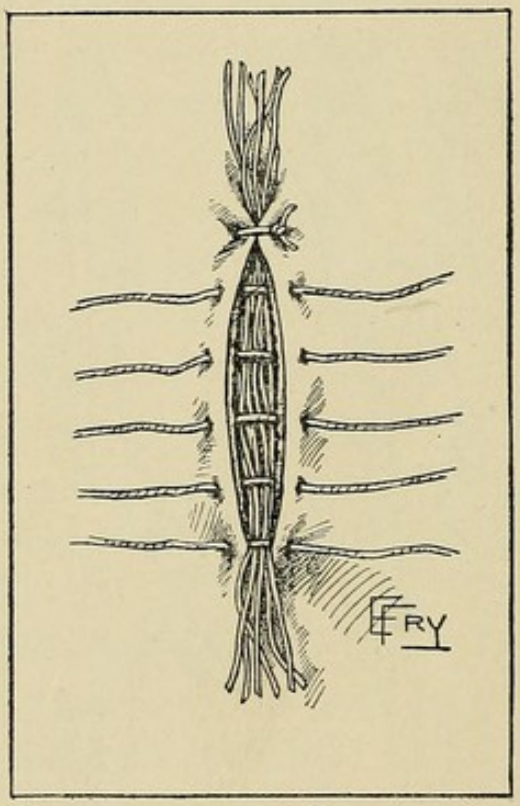


FIG. 4.—Silkworm-gut strands introduced for drainage.

all lacerated wounds of the scalp. Always remember that a normal skull suture can be wiped clean, whereas the red line of a fracture cannot be eliminated.

Simple lacerated wounds should be treated on general principles. Turpentine and benzine are excellent agents for dissolving the grease that is often found smearing the tissues. Surprisingly good re-

sults are frequently obtained in cases of avulsion of the scalp, due largely to its vascularity. These are ideal cases for the transplantation of skin flaps. Thorough removal of all hair from a scalp wound and the surrounding skin is of great importance. A simple and efficient method of draining an extensive scalp wound consists of inserting a number of strands of silkworm gut lengthwise before tying the sutures. (Fig. 4). Continuous warm irrigation is especially applicable to severe lacerated wounds of the extremities. Avulsion of a limb is almost synonymous with a traumatic amputation and will not be considered here.

Lacerated wounds properly dressed at first will require but little after-treatment. Skin sutures should be removed on the eighth day, if of non-absorbable material. They should be gently lifted on one side and snipped with scissors close to the skin, to avoid dragging anything through the stitch hole that has been outside the skin (Fig. 5).

Incised wounds are due to sharp-edged bodies entering the tissues. They are frequently deeper than their superficial appearance indicates, since they gap very little; the integrity of the underlying structures should, therefore, be carefully investigated. Incised scalp wounds bleed freely because the density of the scalp retards retraction of the blood-vessels. A frequently occurring type of incised wound is cut-throat. In these cases the position of the carotid arteries is such that they escape injury as a rule and the greatest danger is not hemorrhage but sepsis. Attempt at suicide is generally made between the

hyoid bone and the thyroid cartilage, and pneumonia is a common sequel.

Incised wounds usually heal by primary union and it is safe to permit this, provided that iodine is used. It will not be amiss to repeat that severed important structures should be accurately approximated, as it is a source of great mortification for the surgeon to find that certain muscles are useless after a wound

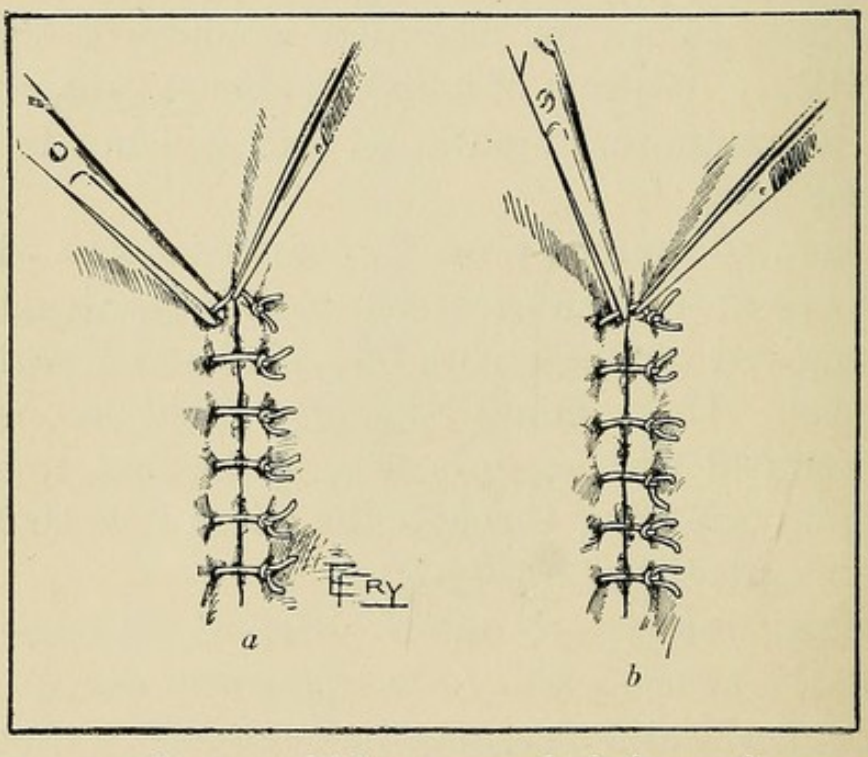


FIG. 5.—*a*, Correct and *b* incorrect method of removing sutures.

has entirely closed. A cut-throat should never be sutured tightly; first, because of the danger of sepsis, and secondly, because the retained extravasation may press upon, or enter if injured, the trachea, thus asphyxiating the patient. The head should be strongly flexed so that position may favor recovery. The dressings should be kept hot and moist to prevent the entrance of cold air and septic matter, thus guard-

ing against pneumonia. Food and stimulation may be administered by rectal enemata.

Punctured wounds are due to pointed objects entering the tissues to a variable depth, are apt to injure important structures and, if penetrating a cavity, infection and suppuration are likely to result. Part of the object inflicting the injury may break off, leaving a foreign body in the wound. A person falling from a height may strike upon some pointed object, impaling a portion of the body. Penetrating wounds are to be distinguished from perforating wounds; the former enter a cavity, while the latter enter as well some organ or viscus within the cavity. It is obvious that punctured wounds should be carefully scrutinized for the integrity of the subjacent important structures and for foreign bodies. Pleurisy and pneumonia not infrequently follow punctured wounds of the chest, hence the necessity for keeping these cases under close observation. Penetrating wounds of the abdomen may gap sufficiently to allow protrusion of the omentum, intestines or other viscera, and are sometimes sufficiently extensive to permit an almost complete evisceration. Naturally, there is profound shock therewith, and great danger of hemorrhage, infection and injury to the viscera.

All punctured wounds should be drained. If a foreign body remains in the wound, it will usually be necessary to enlarge it to permit extraction. A wound communicating with a joint must never be entirely closed, owing to the rapidity with which synovial membrane absorbs toxic material. The danger of sepsis is too great to justify an effort to

secure primary union. Every punctured wound of the peritoneal cavity demands immediate exploratory laparotomy. *Don't* wait for symptoms of perforation or internal hemorrhage before opening the abdomen.

Poisoned wounds are due to infection through an abrasion of the skin or through the sweat or sebaceous glands and are particularly likely to result from conducting dissections and post-mortem examinations. The usual picture presenting is that of cellulitis, and later septicemia. The stings of insects and the bites of snakes and animals may introduce a special poison into the economy, and here the symptoms are those of the poison plus cellulitis. Poisoned wounds due to micro-organisms are commonly termed infected wounds. The treatment may be summed up in five words: incision, evacuation, iodine, drainage and wet dressing. The treatment of infected wounds with vaccines, based on the opsonic theory of Wright, has yielded but poor results in the author's experience. Somewhat better results, however, have been obtained from the use of autogenous vaccines than from stock preparations. Poisoned wounds due to other toxic substances also require prompt incision and drainage. The wound should be shut off from the general circulation by means of a ligature and bleeding is to be encouraged, to prevent the absorption of toxic material. Snake bites are best treated by excision of the wound and potassium premanganate dressings. Patients bitten by a rabid animal should be referred to a Pasteur institute, after cauterizing the wound with carbolic acid and alcohol or the actual

cautery. A nutritious diet and tonics in full doses should be given in all cases of poisoned wounds.

Gunshot wounds are due to the explosion of gunpowder, nitroglycerine, dynamite and other powerful explosives. The wound itself may be produced by powder, wadding, lead or steel bullets, or other missiles. Blank cartridge wounds are particularly dangerous because of the frequent development of tetanus. If a fire-arm is discharged at short range, particles of unburned powder may be driven into the skin. These, however, are of little consequence in themselves, unless on the face where the cosmetic effect is of considerable importance. Needless to say, even a single grain of powder may severely injure the eye. A gunshot wound may have but a single aperture, the edges of which are inverted, or, if the missle emerges, a wound of exit also, the edges of which are everted. The presence of one or more wounds will, as a rule, indicate whether or not the foreign body remains in the tissues. A bullet is likely to be deflected from its apparent course by striking firm tissues, cartilage or bone. In simple bullet wounds, the heat generated by the passage of the projectile is sufficient to sterilize the tract so that infection is not common except in the peritoneal cavity. The amount of contusion of the soft parts will vary inversely with the velocity of the bullet; the slower the bullet travels the greater will be the contusion and laceration. The resistance of the parts decreases the speed of the projectile considerably, so that there is generally more destruction of tissue at the wound of exit than at the point of

entrance. If the bullet is still within the body, its exact location should be determined as accurately as possible without inflicting further damage upon the injured parts. Inspection, palpation and the *x*-ray may be safely employed for this purpose, but rough probing and blind dissection are harmful and unjustifiable. When a large blood-vessel that cannot be reached easily has been injured, enlargement of the wound to control hemorrhage is indicated. A bullet may lie deeply imbedded in the tissues for years without giving rise to any annoying symptoms. In general, gunshot wounds may be considered as differing but slightly from contused and lacerated wounds and compound factures. The severity of the damage sustained by the tissues may vary from an insignificant sterile wound, requiring little or no attention, to the destruction of a large area, necessitating amputation of an entire limb. In severe gunshot wounds, as in other extensive injuries, there is profound shock.

Powder grains beneath the skin should be picked out with a needle or sharp bistoury or scrubbed out with a stiff brush under anesthesia as soon as possible, because the longer they are allowed to remain the more pronounced will be the resulting indelible blue stain. All cases of gunshot wounds contaminated with soil and all blank cartridge wounds should receive an immunizing dose of tetanus antitoxine. An effort to save all tissue not entirely destroyed should be made, and the recuperating power of a part will vary in direct proportion to its blood supply. A bullet deeply imbedded in the

tissues should be accurately located with the *x*-ray. Its subsequent removal will then depend upon the situation of the bullet, the amount of damage it has inflicted and the patient's condition. In every bullet wound of the abdomen immediate exploratory laparotomy is imperative, unless it is *positive* that the peritoneal cavity has not been entered, for the mesentery, intestine, stomach, bladder or some other important structure is almost invariably injured. The entire cavity and its contents should be explored to assure that no perforations are overlooked.

CHAPTER III.

TRAUMATIC INJURIES OF JOINTS.

Those inflammations resulting from joint injuries depend upon the nature and severity of the inflicting violence and the location sustaining the damage. As a rule, low grade inflammations, such as osteo-arthritis and arthritis deformans, result from disease rather than traumatism, and a constitutional diathesis should therefore always be accorded due consideration. So-called "hysterical joints" are often the source of serious error and should be excluded. In such instances, the patient is of a hysterical or neurotic temperament, the skin is more sensitive to pressure than the underlying parts, characteristic attitude is lacking and although the patient will state that the joint cannot be moved, he will move it unconsciously. Mensuration and comparison with the joint on the opposite side are valuable aids in the examination of joints. In all joint inflammations muscular rigidity causes an apparent loss of motion far beyond what is absolutely present. This condition must be differentiated from ankylosis, but since anesthesia will dissipate muscular rigidity, the diagnosis is easy. True joint crepitus depends almost entirely for its existence upon roughness of the articular cartilages. Crepitus is always absent in complete disorganization.

BURSITIS.

Bursæ are distinct sacs but sometimes communicate with joints. The types of bursitis from a clinical view-point are: (1) serous, (2) suppurative, (3) chronic, (4) tubercular and (5) syphilitic. Although any of the normal or anomalous bursæ may be subjected to direct violence, bursitis is most frequently observed in front of the patella (housemaid's knee), behind the olecranon process, and over the great toe (bunion).

Simple serous bursitis is best treated with rest of the part, counter-irritation and the ice bag. The bursa may be aspirated and pressure exerted by the application of an elastic bandage. If these measures fail to cure, complete excision of the bursa is indicated.

Prepatellar bursitis is frequently suppurative, and unless speedily drained the pus quickly invades the cellular tissues. If the infection is still limited to the bursa itself, incision, drainage and packing the cavity with gauze may effect a cure, as adhesions rapidly obliterate the sac. Not infrequently, however, it will be necessary to dissect out the bursa and drain.

Chronic serous bursitis can often be cured by tapping and afterwards injecting equal parts of carbolic acid and tincture of iodine. Tubercular and syphilitic bursæ require excision. Great care should be exercised that the adjacent joint is not opened.

In the treatment of bunion, it will often be a

great temptation to temporize with circular felt or plaster shields, or to incise and drain the joint. These measures do not entirely relieve the condition, and removal of the thickened outer condyle of the metatarsal bone is essential to complete cure. An incision should be made between the great toe and the next one, and the phalanx dislocated. The head of the metatarsal bone may now be resected from the inside, thus obviating a lateral scar to rub on the patient's shoe.

TRAUMATIC SYNOVITIS.

This condition usually begins as an acute infection, although chronic synovitis frequently occurs as the result of an uncured acute inflammation. The joint fills up with serum a few hours after the injury, there being but slight local heat and pain (aggravated by pressure or forced motion), while redness is never present. The swelling is always more pronounced where the protection of the muscles and other tissues is least. When the synovitis has persisted for a considerable length of time, the patient will experience a sense of weakness and insecurity in the joint, accompanied by more or less limitation of motion and muscular atrophy. The prognosis is excellent, except in debilitated subjects in whom it occasionally terminates in suppuration.

The treatment is simple. A snug dressing of lead and opium wash, covered with an ice bag, and the placing of the joint at rest temporarily by means of an elastic bandage, adhesive straps or

splints are usually sufficient to effect restoration of function and a complete cure in a few days. In the more severe and prolonged cases it will be necessary to aspirate the effusion under rigid aseptic precautions and follow with fixation of the joint and counter-irritation. Rarely, incision and drainage of the joint are required to relieve a suppurative process. Passive motion, massage and hot air baths are useful adjuvants in the after-treatment.

TRAUMATIC ARTHRITIS.

Acute arthritis is a simultaneous inflammatory involvement of all the structures comprising a joint, and with few exceptions is due to pyogenic organisms, introduced through an open wound. It may begin as a purulent synovitis or may involve the entire joint primarily. Likewise, it may occur secondarily to an acute osteomyelitis. The synovial membrane becomes succulent, the quantity of synovial fluid is rapidly increased, the cartilages necrose and erode and the ligaments soften. Unless drainage is immediately instituted, the capsule may perforate and the pus permeate the bone and soft structures above and below the joint. The pain and tenderness are far greater than in synovitis and all the manifestations of a local and general septic process soon present themselves. Grating on motion may or may not be present, depending upon the degree of fixation of the joint occasioned by the rigidity of the adjacent muscles.

Since a peri-articular pyemic inflammation may simulate a true arthritis, it is wise to aspirate the

joint for diagnostic confirmation. Until the diagnosis is definitely established, a splint and ice bag may be employed.

Early and prompt incisions and through-and-through drainage are imperative. The drainage tubes should be run through the joint from one side to the other and must be frequently irrigated with physiological saline solution; twice daily is none too often. It is advisable to avoid antiseptic solutions, because they may aggravate the inflammation, thereby predisposing to a resulting ankylosis. To irrigate the tubes conveniently, the hard-rubber tip of a Davidson syringe may be inserted in one end of the drainage tube and the fluid forced through into a suitable receptacle. During the intervals between the irrigations the joint should be immobilized and enveloped in a generous wet dressing. If these measures fail to arrest the septic process, the joint must be resected or the limb amputated.

SPRAINS.

A sprain is a violent straining, separation of the fibers, or rupture of one or more ligaments of a joint without permanent displacement of bone. Sprains are usually due to a wrench or twist and are most common at the ankle and wrist. Not infrequently a small piece of bone is torn off and the injury is then termed a sprain-fracture; these are the cases that are most often followed by ankylosis. Although apparently trivial as a rule, they should never be neglected and should receive a gentle but thorough and careful examination, because

of the danger of confusion with separation of the epiphysis (in children), dislocation and fracture. The nature of the case is often obscured by the swelling that is rapidly produced by the effusion of blood and serum into the joint and adjacent tissues. An anesthetic should be administered or an *x*-ray examination made, rather than an error in diagnosis committed. Laceration or rupture of tendons near the site of injury must not be overlooked, as they are usually responsible for delayed restoration of function and may seriously cripple the joint thereafter. Rupture of muscular or tendinous fibers of the muscles of the back is often referred to as a "sprained back" and occurs in consequence of a severe strain from lifting heavy weights, or extreme pressure exerted thereon. A stretching of the annular ligament of the wrist causes a weakness at the joint and is often spoken of as a sprain. Unless every sprain is accorded adequate attention and is treated properly, impairment of function, permanent stiffness, tenosynovitis and even joint disease may result.

Emergency treatment of sprains will depend upon the severity of the injury and the degree of swelling already present. If the sprain is a mild one and is seen early before there is much subcutaneous effusion, it is best treated from the beginning by daily gentle massage, especially over the areas immediately above and below the tender and inflamed joint. After each séance a wet dressing, preferably of lead and opium wash or aluminum acetate, should be applied and use of the joint

should be encouraged. The exception to this generalization is a recent sprain of the ankle which, *in the absence of swelling*, should be strapped with strips of adhesive plaster in the manner recommended by Gibney and Cotterell (Fig. 6), and the whole covered with a snugly fitting gauze bandage.

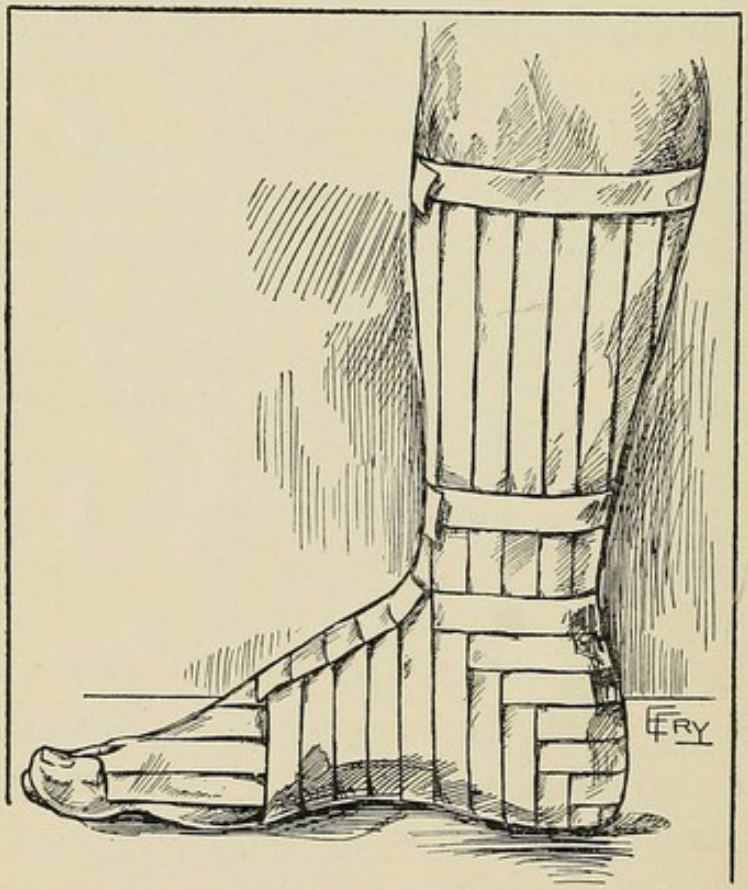


FIG. 6.—Strapping of sprained ankle-joint.

With this dressing properly applied, the patient may be permitted to walk upon the foot. Before applying the adhesive straps the leg should be shaved and wiped dry and the foot held in proper position by an assistant (the foot should be ducted *toward* the sprained side). One and a half inch wide strips of adhesive plaster are criss-crossed at

right angles until the entire joint has been covered. The first starts two-thirds up the leg on one side, close to the tendo Achilles, crosses the sole of the heel and terminates two-thirds up the other side of the leg. The next begins at the base of the little toe on the dorsal surface of the foot, passes around the posterior aspect of the heel and ends at the base of the great toe. Additional strips are applied alternately in like manner, each one just overlapping the previous one, until the ankle-joint is completely included. A single circular strap is then placed above the malleoli and another at the upper limit of the straps on the leg. This dressing should be left undisturbed for ten days. To faciliate painless removal of the adhesive plaster, it may be saturated with oil of wintergreen or gasoline. If there is considerable extravasation when first seen, the Gibney strapping should be deferred until the swelling has subsided.

Sprains of a more severe character require the prevention or reduction of swelling and immobilization. The first may be secured by the use of hot, cold or anodyne applications and pressure; the second by a sling, splint or plaster-of-Paris bandage. If seen before much effusion has occurred, the plaster-of-Paris bandage may be applied at once, but it should never be used in the presence of any great degree of distention of the joint. If much time has elapsed and the joint is swollen, a cooling application should be applied on gauze, covered with an elastic bandage, and the limb placed in a sling or supported by a splint.

A "sprained back" should be strapped from below upward with strips of adhesive plaster two inches wide, from the third sacral vertebra to the level of the first lumbar vertebra (Fig. 7).

After-treatment of Sprains.—Mild cases are best treated by daily massage and passive motion, being

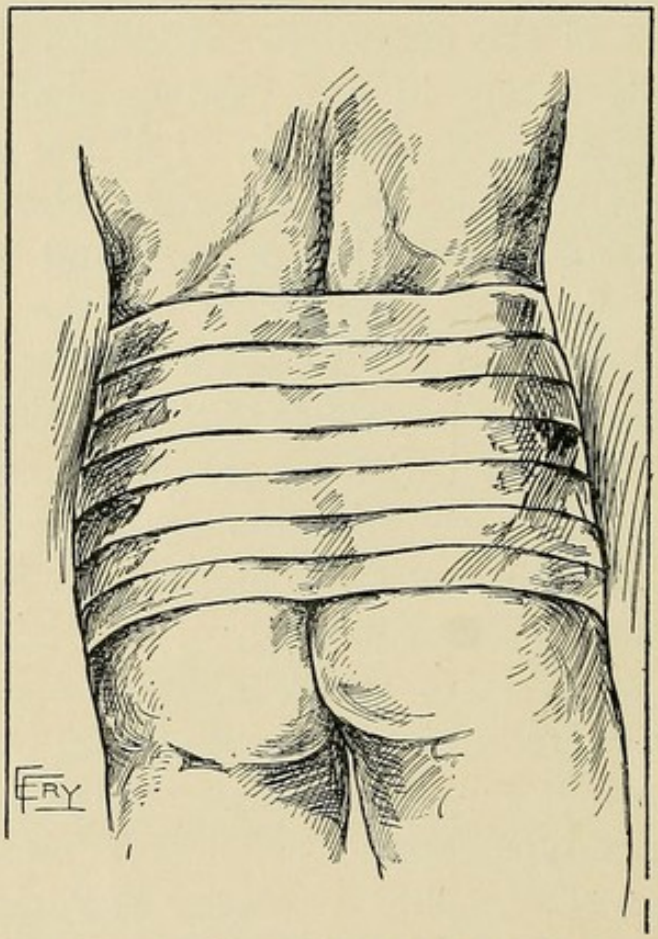


FIG. 7.—Strapping a sprained back.

supported during the intervals without restricting motion to such an extent that the joint cannot be used. The lack of power in the wrist due to stretching of the annular ligament is best overcome by supporting it with a circular leather strap.

Severe cases demand complete rest and constant

wet dressings until the greater part of the effusion has been absorbed and all swelling has disappeared, when gentle massage, passive motion and gradual use of the joint may be introduced. These efforts, however, should never be of sufficient force to cause pain. The faradic and galvanic currents and superheated air will also be found excellent aids, particularly if there is atrophy of the muscles. Usually five or six weeks elapse before there is complete restoration of function. After exceptionally severe sprains, the formation of firm adhesions will occasionally so retard the progress that it will be nesessary to break them up forcibly under an anesthetic.

DISLOCATIONS.

A dislocation is a displacement of the articular surfaces of the bones entering into the formation of a joint, accompanied by rupture of the joint capsule, which bones tend to retain an unnatural position. Congenital dislocations and pathological dislocations due to disease are not within the scope of this chapter and traumatic dislocations only will be considered. They are usually due to indirect violence and occur most frequently at the shoulder-joint. The capsule of the joint is necessarily always ruptured and if the force exerted is sufficient, tendons, muscles, nerves, blood-vessels and even the skin may be bruised or torn. In general, we may expect to find tenderness, swelling, shortening, deformity at the joint with projection of the extremity of one or more bones, more or less reflex muscular rigidity and an unatural position of the limb, assumed involuntarily.

Examination of Dislocations.—A dislocation may be simple or compound, or complicated by fracture of either the articular surface or the shaft of one or more bones. The existing pathological condition should be exactly determined before any attempt at reduction is made. Otherwise, irreparable harm, such as permanent deformity, neuritis, local paralysis, muscular atrophy, adhesion of blood-vessels and nerves to bone and even complete ankylosis, may result from the surgeon's misdirected efforts. Recent dislocations should be differentiated from ancient dislocations. The latter are often misleading because the joint cavity may be entirely obliterated by adhesions and they often present a spurious form of crepitus, due to organized effusion in the surrounding tissues. The limb may atrophy from lack of use and if the injury is neglected for a sufficiently long time, a false joint not infrequently results. If the first attempt at reduction fails, palpation under anesthesia and the *x*-ray should always be employed to establish positively an accurate diagnosis and facilitate manipulation. It is of the utmost importance to note whether or not the head of the bone rotates with the shaft; if it does not, there is probably a fracture near the epiphysis. In the presence of an impacted fracture of the neck of the bone, however, the head will rotate with the shaft.

Dislocations of the jaw should not be confounded with a fracture at the neck of the condyle. In fracture there is mobility, while a dislocation is immobile.

Dislocations at the shoulder-joint are the most

common of all, and the proximity of the brachial vessels and nerves renders a correct diagnosis of special importance. In subcoracoid dislocation the elbow cannot be made to touch the side of the chest, with the hand on the opposite shoulder; while if the fingers cannot touch the space beneath the acromion process, a fracture has probably occurred. A dislocation does not tend to recur after reduction. In most fractures it is extremely difficult to maintain proper position of the fragments. In subclavicular and subglenoid dislocations there is more abduction of the arm and more tension on the skin. Subacromial and subspinous dislocations are posterior displacements and the position assumed by the arm is the reverse of anterior dislocations: adduction and inward rotation. Luxatio erecta and supracoracoid dislocations are extremely rare and easily reduced.

Dislocations at the elbow are more common in early life and the diagnosis is usually easy. There may be backward dislocation of the radius and ulna, forward dislocation of the radius and ulna (usually complicated by fracture of the olecranon), lateral dislocations, or dislocation of the radius forward (commonly associated with fracture of the ulna).

Backward dislocations of the thumb are often complicated by the anterior ligament or the flexor tendons slipping between the two bones and are then extremely difficult to reduce.

Dislocations of the hip are relatively uncommon, but it is important to distinguish between dorsal and anterior dislocations. In dorsal, or posterior,

dislocations there is flexion, adduction, inversion, shortening, and the head of the femur lies above Nélaton's line. These symptoms are more marked in dislocations on the ilium than when the head of the bone lies in the sciatic notch. Anterior dislocations are either pubic or obturator (thyroid). In the former the thigh is abducted and everted, the hip is flattened and the prominence of the great trochanter disappears, and there is some shortening. In the latter variety there is also flattening and eversion, but there is lengthening instead of shortening. In all anterior dislocations of the thigh the legs cannot be approximated. Dislocations are easily differentiated from fractures in this region, but the possibility of a fracture occurring simultaneously should be borne in mind. In such instances it is better to consider the injury as a fracture than as a dislocation, as attempts to reduce the dislocation usually fail. Supracotyloid, infracotyloid and perineal dislocations are anomalous varieties, occurring very rarely and are reduced without difficulty.

Treatment of Dislocations.—Having established the diagnosis of a dislocation, the treatment should be instituted promptly, as a profuse extravasation of serum and blood into the injured area, which increases as time elapses, may seriously interfere with our efforts at reduction and complicate the result. The treatment may be said to consist of: (1) reduction (restitution of the displaced parts to their normal relationship), (2) retention (prevention of recurrence), and (3) restoration of function. The

first may be accomplished by manipulation, manipulation plus anesthesia, extension and counter-extension, or arthrotomy; the second by the application of a suitable dressing, firmly fixing the parts in their normal position; and the third by massage, passive motion, hot air and electricity.

Simple forcible manipulations are quite often sufficient to effect a complete reduction, but when the first attempt fails recourse to other methods should be considered. The obstacles to reduction usually encountered are : (1) reflex muscular rigidity, (2) voluntary muscular opposition, (3) a small rent in the capsule and (4) interposition of a fragment of the capsule, nerves, fascia, or some other soft structure. Of these, muscular rigidity is the most common and may easily be eliminated by general anesthesia, pushed to complete muscular relaxation. Ether is the safest anesthetic for this purpose. The relaxation afforded by the first stage of anesthesia may seem sufficient to permit reduction, but it must be remembered that the patient will still be conscious of the pain produced by the manipulations and dangerous shock may be occasioned thereby. Manifestly, it is better to wait for complete surgical anesthesia. Extension and counter-extension by means of weights, pulleys, the Spanish windlass, etc., have been advocated by some surgeons as a satisfactory method of enforcing reduction, but with the exception of gradual traction, the danger of injury to the soft parts is so great under such circumstances that the risk is not worth the attempt. Serious laceration or rupture of

the soft structures not infrequently follows, because the force exerted cannot be accurately estimated. When a small rent in the capsule or the interposition of soft parts interferes with proper reduction, or a blood-vessel or nerve has been ruptured, an open arthrotomy at the earliest possible moment is the desirable procedure. *No surgical operation should be performed under more rigid aseptic circumstances than an arthrotomy, because of the susceptibility of all synovial membranes to infection.* Having opened the joint, temporary enlargement of the rent in the capsule and reposition of the articular surfaces are easy. Severed arteries, veins and nerves should be carefully ligated or sutured in the usual manner. Ancient dislocations nearly always require an anesthetic in order that the adhesions may be broken up before the attempt to effect reduction is made. Generally, however, an open operation is to be preferred because the danger of laceration of the displaced stuctures is otherwise so great, owing to their changed relations. Complicated dislocations should also receive the benefit of accurate manipulation, afforded by an arthrotomy only.

Having effected a satisfactory reduction, recurrence of the dislocation may be prevented by means of a firm dressing fixing the parts in their normal positions. This may consist of a bandage or plaster-of-Paris support, superimposed upon a wet dressing if there is much effusion.

Torn ligaments usually heal in about three weeks and it is then safe to commence massage and passive motion. They should preferably be carried

out by the surgeon, in order that the daily dose may be regulated satisfactorily. Applications of the faradic current will also be found a valuable aid in these conditions.

A displaced coccyx with resulting coccygodynia is an exceedingly painful and annoying condition; coccygectomy only will give relief.

Ankylosis is not due to immobilization, but to inflammation and its products. If forcible motion causes pain, the ankylosis is fibrous in character; if no pain is produced, it is bony. The former is best treated by forced motion, either with or without an anesthetic, or gradual traction. The pain following these manipulations should not last longer than an hour or two; if it does, harm is being done. Bony ankylosis necessitates an open operation and the removal of a wedge-shaped piece of bone.

CHAPTER IV.

SIMPLE FRACTURES.

Simple fractures are closed fractures having no communication with the exterior. They may result in two fragments only, or several (comminution). Epiphyseal separations, green-stick, fission and depressed fractures are anomalous varieties. In no other class of injuries is accurate diagnosis and exact treatment of such paramount importance, because every patient that has sustained a fracture will become an ambulatory example of the surgeon's ability and skill, or his limitations and incapability. Also, these cases are frequently the basis of a malpractice suit. Every detail contributing to the complete anatomical, cosmetic and functional recovery of the injured part should receive careful consideration, and the patient should always be immediately informed of the probable result. Strict obedience to orders must be insisted upon, in order that the patient may do nothing that might jeopardize his best interests.

Examination of Fractures.—All fractures should be examined as early as possible, since extravasation into the injured area may obscure a great deal of valuable information. The patient's general condition is always of great importance; the bodily nourishment and development, the condition of the pupils and their reaction, partial or complete

unconsciousness, the degree of shock present and the occurrence of other complications and injuries should be carefully noted. Thorough investigation will disclose whether a fracture is simple or compound or complicated, complete or incomplete, and the line of fracture. The nature of the displacement will necessarily depend upon the line or lines of fracture and the action of various muscles.

On inspection, any muscular spasm, deformity, swelling or discoloration are observed, and the contour of an injured limb compared with that of its fellow. Palpation must be exceedingly careful and gentle, to avoid causing pain or injury to the adjacent structures, but preternatural mobility and crepitus must be diligently searched for. In those instances, however, where the nature of the injury is obvious, it is cruel and unnecessary to twist the site of fracture about simply to elicit crepitus and, in addition, forcible movements tend to damage the soft parts and increase extravasation. Mensuration is also of great value for the determination of the exact extent of displacement. Loss of function and subjective pain are usually self-evident and are important symptoms. All obscure cases and fractures near joints should be examined under anesthesia, as well as those occurring in children and nervous individuals. The *x*-ray is of inestimable service for the definite location of a suspected fracture and for confirmation of a diagnosis. It should be remembered that a radiograph taken from the anterior or lateral aspect alone is likely to deceive, and the *x*-ray examination should therefore always

include *both* an antero-posterior and lateral view. An *x*-ray photograph, also, is much more reliable than a simple fluoroscopic examination.

The two most constant errors in diagnosis are mistaking a pre-existing deformity for a recent fracture and confusing joint crepitus with that of a fracture. The inexperienced may be misled by the crepitus due to calcareous deposits in the joints or teno-synovitis, and conversely, the interposition of muscle or fascia between the fragments may eliminate crepitus. When dealing with children, special care should be exercised to differentiate separation of an epiphysis from a true fracture. Simple fractures are often accompanied by more or less aseptic fever and shock. This fever must be distinguished from that of sepsis, which signifies complications. The increased leucocytosis present in sepsis is a reliable diagnostic guide and is usually sufficient to differentiate.

Emergency treatment of fractures consists only of those measures that will make the patient temporarily comfortable and prevent further injury, although most fractures of the upper extremity and thorax may be dressed immediately. Since by the very nature of these emergency fractures they cannot be accurately catalogued, the extent of advisable investigation and manipulation must be left to the surgeon's discretion. Clothing should be removed, being cut or torn away if necessary, any marked deformity reduced and the limb placed in a suitable position. The site of injury may be covered with a wet gauze dressing and the entire part supported

with splints lined with cotton or oakum. For security, splints are best fixed with adhesive plaster before bandaging. All precautions should be taken that rough or careless manipulations do not convert a simple into a compound or complicated fracture. If the patient is in severe pain, one-quarter of a grain of morphine may be administered hypodermatically. Alcohol and other stimulants are contra-indicated.

Permanent Dressing of Fractures.—All fractures are advantageously reduced as early as possible, except when the extravasation and tension are extreme. Under such circumstances manipulations are dangerous and it is better merely to place the limb in a comfortable position and surround it with sand bags, until the wet dressing has reduced the swelling. Having accomplished reduction of the fracture, we have at our disposal four methods of treatment for simple fractures: (1) immobilization by splints and bandages, (2) fixation by extension, (3) immobilization plus massage and (4) open operation, each of which has distinct value in selective cases.

Splints may be made of wood, wire, metal, starch, or any other light and rigid material. Whenever practical, moulded plaster-of-Paris splints will be found the most servicable. This does not necessarily imply complete encasing of the injured part, but one section of several turns, back and forth, of the required width and length moulded on the anterior half, and another similar section moulded to the posterior half of the injured part; when firm, they are bandaged together. A plaster dressing should al-

ways include the proximal and distal joints from the seat of injury, and by beginning the underlying gauze bandage at the distal extremity of the limb, annoying edema will be eliminated. The same rules apply to splints of any other substance.

Fixation by extension is most often utilized for fractures of the lower extremity, and all joints below the fracture are included in the dressing. The steps in applying an improvised extension apparatus are:

1. Cut an appropriately wide strip of adhesive plaster of sufficient length to leave a loop projecting four or five inches below the heel.

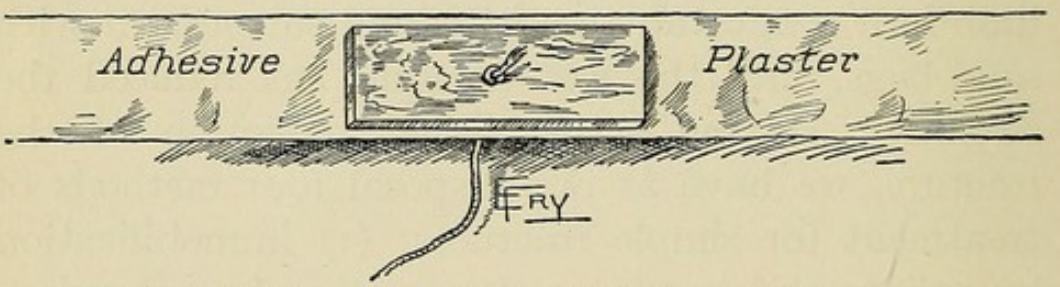


FIG. 8.—Improvised extension apparatus.

2. Place an oblong piece of wood about one-quarter of an inch thick in the site of the loop on the sticky side of the plaster, and punch a hole through the center.

3. Knot a piece of heavy cord and run it through the perforation, with the knot on the inside (Fig. 8).

4. Apply the plaster laterally to both sides of the leg (Fig. 9) and fix with a firm gauze bandage, including the toes.

5. Reduce the fracture and have an assistant maintain constant traction.

6. Fix an ordinary wooden spool horizontally at

the foot of the bed at a level that will slightly elevate the limb.

7. Attach the necessary weights (usually about eight pounds) to the free end of the cord.

8. Apply coaptation splints to the site of the fracture. They are preferably lined with cotton and secured with adhesive plaster.

9. Pad the entire limb with cotton and bandage two lateral splints the whole length of the extremity.

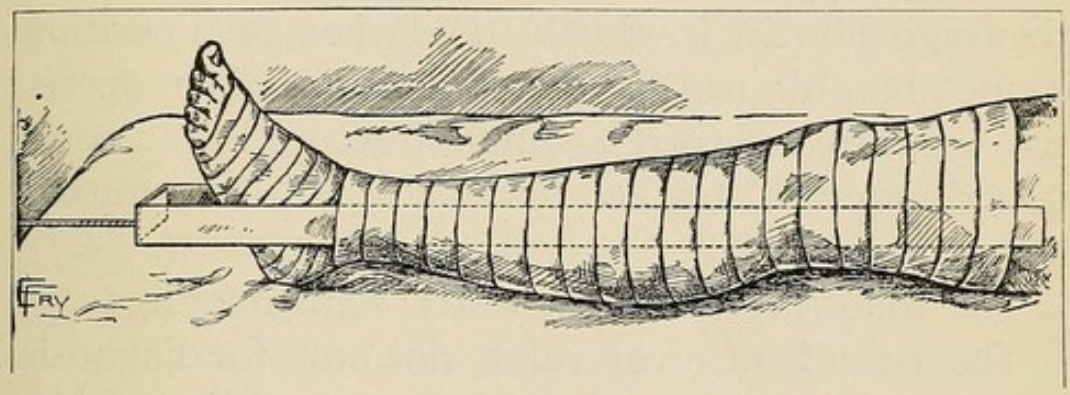


FIG. 9.—Improvised extension apparatus applied.

Even though daily massage is selected as the method of treatment in a given instance, the injured part must be supported with splints during the intervals. The field of this procedure is limited to Colles' fractures and single transverse fractures, since in all other fractures accurate approximation cannot be maintained without constant external support. The results in appropriate cases, however, have been most satisfactory.

Open operation on simple fractures has recently been widely practised and recommended, on the ground that it assures a more exact appoximation of the fragments than any other method of treat-

ment. In opposition to this reasoning, it must be remembered that tight suturing establishes such conditions of leverage that the maintenance of precise adjustment is at best uncertain, repair is slower, and we must still depend largely upon external support. While admitting that the risk of infection is a negative quantity, in view of modern surgical technic, operative measures are positively indicated in simple fractures only when approximation and union are obstructed by the interposition of soft structures, or the fragments are irreducible, and when good position cannot be obtained by manipulation. Since operative measures convert a simple fracture into a compound fracture, further discussion will be omitted here.

The following facts are worth remembering:

The *x*-ray is of great value, not only for diagnosis but also for confirmation of good position of the fragments after reduction.

An anesthetic will overcome muscular opposition.

The recumbent position in the aged tends to induce hypostatic pneumonia; at least a semi-erect position should be insisted upon.

A great deal of unsuspected contusion and subcutaneous extravasation may become manifest during the first week or ten days.

The longer a fracture remains unreduced the greater will be the muscular rigidity.

Gravity must be counterbalanced so that position will assist restitution.

All fracture dressings should exert uniform pressure throughout their entire length.

A dressing applied too loosely will permit motion of the fragments, while if applied too tightly it will interfere with the circulation.

Apply coaptation splints to the site of all fractures treated by extension.

Contused areas should not be covered with plaster-of-Paris.

Morphine should not be given to patients wearing a plaster cast, because the pain due to the faulty position of an ill-fitting cast or pressure sores can be endured when morphine is given, although the cast should be removed.

No attempt should be made to break up an impaction if the fragments are in good alignment.

An epiphyseal separation is analogous to a transverse fracture.

Correct the deformity of a green-stick fracture so that it does not tend to recur.

FRACTURES OF THE SKULL.

Those of the vault may occur as fissure, penetrating, depressed or bursting fractures. There may be a linear fracture of the external table only when the inner table is extensively splintered, because the latter is thinner and more brittle and the diploë distributes the force over a wider area. Depressed fractures are invariably associated with brain injury and practically all fractures of the skull are accompanied by some symptoms of cerebral concussion, laceration or compression. These are the danger signals, since injuries to the brain and its membranes may terminate in meningeal hemorrhage, meningitis,

encephalitis or cerebral abscess. Infection and necrosis due to insufficient drainage and loose fragments are also serious consequences. In fracture by *contre-coup*, as the name indicates, the fracture is on the other side of the head; *opposite* to the site of injury. Although the diagnosis of fractures of the skull may be easy, it often taxes our diagnostic acumen. Fissures, depressions, mobility, crepitus and local pain and tenderness should be diligently searched for and the functional integrity of the brain and nerves ascertained. Explorative incision is of the utmost value as a diagnostic aid. When a fracture is suspected but not demonstrable, the scalp should be freely incised and the skull trephined. This will permit inspection of the inner table and dura. The brain may be explored, if necessary, by incising the dura and using a probe. By so doing, the underlying conditions can be ascertained and no errors of omission will be made.

Fractures at the base may involve the anterior, middle or posterior fossa, and the latter are graver because of the proximity to the medulla. In addition to cerebral symptoms, these fractures are usually evidenced by hemorrhage behind the eye, from the nose, into the pharynx, or from or behind the ear, or by indications of injury to nerve trunks. Not infrequently the cranial nerves are damaged and cerebro-spinal fluid or even fragments of brain tissue may escape from the nose or ear.

The tables on pp. 74–77 are intended to illustrate the differential diagnosis of head injuries associated with brain injury. An alcoholic odor to the breath

is of no diagnostic significance whatever, because some well-intending by-stander will often give whiskey or brandy to an injured person, before the surgeon's arrival, and the fact that a person is intoxicated is no proof that his skull is not fractured.

The prognosis is uncertain: about 75 per cent. of fractures of the vault and 50 per cent. of fractures of the base recover. A common sequel is sunstroke, occurring at the next exposure to intense heat, and these patients should be instructed accordingly.

The following suggestions are applicable to all severe injuries of the head:

Confine the patient to bed.

Avoid cardio-vascular stimulation, especially hypodermic injections.

Shave the injured area or the entire scalp.

Apply an ice cap.

Secure free movements of the bowels.

Keep the room dark and absolutely quiet.

Good nursing and constant careful observation are items of the utmost importance. Stimulants are dangerous because they increase arterial tension, although in exceptional instances they are required to combat shock, but even under such circumstances they should be withdrawn as rapidly as the existing conditions will permit. Croton oil is the most satisfactory purgative as it acts quickly and lessens blood pressure. Two or three drops may be placed on the patient's tongue, or, if he is unconscious, it may be administered in an enema of olive oil, containing four or five drops of croton oil. A simple

	General Appearance	Appearance of the Injury	Unconsciousness	Pupils
Scalp Wounds.	Normal.....	Bone may be exposed, but normal skull sutures can be wiped clean. No persistent red line of hemorrhage. The hematoma never pulsates.	Conscious.....	Normal. Equal and react promtly.
Alcoholic Poisoning.	Bloated. Lips livid. Red face and nose.	No evidence of injury.	May be momentarily aroused by inhaling ammonia or pressure on the supraorbital nerve.	Generally dilated, but active. React to light.
Cerebral Concussion.	Face pale...	No manifestations of injury, or at most a simple fissure fracture.	Semi-unconsciousness. Mind weak and confused, but not abolished. Occasionally totally unconscious.	Variable. React to light. Eyelids somewhat open.

Pulse	Respiration	Stomach, Bowels, and Bladder	Coma	Convulsions	Mental, Motor, and Sensory Disturbances
Normal....	Normal...	Negative.....	Absent.	Absent.	Absent.
Full and soft.	Deep, slow and stertorous.	May be vomiting.	Possibly gradual.	Do.....	Mental dullness and motor weakness. Incoordination of muscles.
Small, rapid and intermittent.	Quiet. Shallow and irregular.	Vomiting after recovery of consciousness. Involuntary defecation and micturition at times.	Temporary.	Do.....	Mentally depressed. Occasional delirium. Temperature subnormal, gradually rising as reaction occurs.

	General Appearance	Appearance of the Injury	Unconsciousness	Pupils
CEREBRAL CONTUSION (severe concussion).	Face pale. Expression vacant.	Do.....	Temporary.....	Still somewhat sensible to light.
CEREBRAL LACERATION.	Face pale. Skin cold. Profuse perspiration.	Usually evidence of fracture.	More prolonged; followed by irritability and restlessness.	Do.
CEREBRAL COMPRESSION.	Face pale. Skin cold.	Usually depressed fracture. Hematoma pulsates. May be due to concealed hemorrhage, in the absence of fracture.	Comes on immediately when due to bone pressure; gradual development of symptoms when due to hemorrhagic pressure. Tends to progress.	Remain fixed. One or both may be dilated or contracted. Do not react to light. Eyelids closed.

Pulse	Respiration	Stomach, Bowels and Bladder	Coma	Convulsions	Mental, Motor, and Sensory Disturbances
Feeble and irregular.	Do.....	Do.....	Do.....	Do.....	Power of movement not destroyed. Mentally depressed, plus shock and general depression.
Do.....	Do.....	Do.....	Do.....	Occasional.	Mental irritability. Hemiplegia, if motor areas are injured. Legs and arms flexed. Lasts some days.
Slow. (sometimes 40–60) and full.	Labored and stertorous.	Stomach insensible, even to emetics. Bowels torpid.	Lasts as long as pressure exists.	Do.....	Partial or complete paralysis. Special senses entirely suspended.

fissure fracture without depression of bone or brain symptoms will require no additional treament. All depressed and punctured fractures and those exhibiting symptoms of brain injury demand immediate operation. The skull should be trephined and the depressed fragments elevated and cleansed or removed. Any piece of bone with good periosteal attachments will not become necrotic and should be left *in situ*. If there is hemorrhage from the dura, the bleeding vessel must be ligated, while if it originates in the brain proper or follows the removal of bone fragments the wound should be packed with narrow strips of sterile gauze. Provision for drainage is essential in all these cases.

In fractures of the base with hemorrhage or exudation from the nose or ear these cavities should be wiped clean with a little moist cotton on an applicator and loosely plugged with sterile cotton, which should be changed as often as it becomes saturated. Irrigations are dangerous as they may carry infection into the fissures. In addition to these measures, the treatment is symptomatic.

In gunshot fractures of the skull the bullet should be removed if reasonably accessible, as the mortality is considerably greater if the bullet is permitted to remain. Nevertheless, it is sometimes wiser to leave a harmless bullet in the tissues than to perform an extensive and destructive operation for its removal.

FRACTURES INVOLVING THE NOSE AND MOUTH.

The cardinal principle in the treatment of these fractures is cleanliness. The cosmetic result is of

great importance so that exact adjustment and firm fixation by means of splints or operative procedures at the earliest possible moment is imperative. In fractures of the nose the mucous membrane should be cocainized and cleansed with a little sterile cotton on a probe. Hemorrhage is controlled by injections of ice water, applications of adrenalin chloride (1–1000) or packing with gauze strips. The fracture may be reduced and proper position of the fragments maintained by elevating the spicules with a director and introducing an Asch's or Coleridge's splint, if

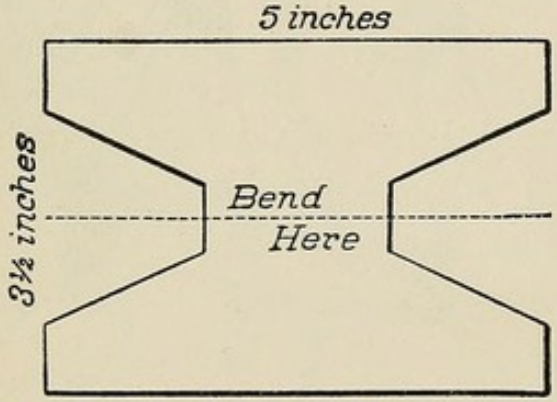


FIG. 10.—Cardboard cut for cup-shaped splint for lower jaw.

necessary. Fractures of the superior maxilla usually require instrumental reposition of the fragments, suturing and drainage. Little or no tissue need be removed, because of the vascularity of this region. In fractures of the lower jaw, a cup-shaped splint and a Barton bandage are often all that will be necessary. To apply this dressing:

1. Cut a piece of cardboard of appropriate size, as shown in Fig. 10.

2. Steam over boiling water.

3. Mould to the chin and line with cotton.

4. Begin a 2 1/2 inch wide muslin bandage diagonally at the vertex of the head, bring down on one side of the face, under the jaw, up the other side, across the starting-point, down around the occiput, across the anterior surface of the jaw, around the

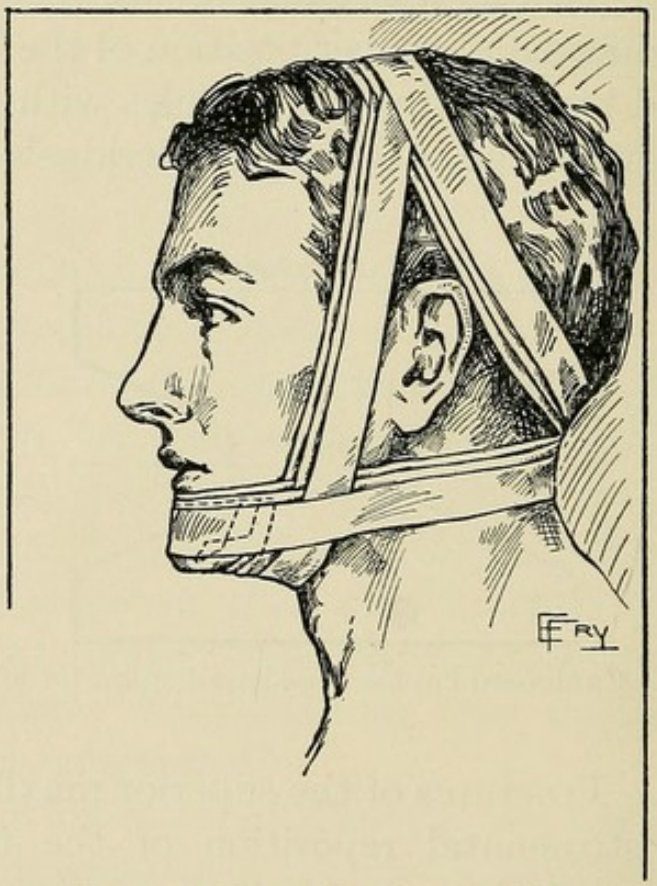


FIG. 11.—Barton bandage applied.

other side of the occiput and up to the starting-point. This is really a double figure-of-eight bandage (Fig. 11).

5. Re-apply the dressing every two or three days.

In severe cases, or whenever this dressing is inadequate, recourse may be had to an interdental

splint or wiring of the teeth. Open operation and wiring of the bone fragments is to be avoided if possible, because of the great danger of necrosis and sepsis therefrom. Where the damage is extensive, dental prosthesis is of considerable aid to the surgeon. Talking and mastication must be interdicted, the mouth washed out with a mild antiseptic every two hours and immediately after eating and the teeth kept scrupulously clean. The diet should be entirely liquid and administered through a tube.

FRACTURES OF THE RIBS AND SPINE.

Fractured ribs are best treated by strapping with strips of adhesive plaster from below upward, beginning at the spine and ending at the sternum, on the affected side only. Surgical emphysema occasionally accompanies these fractures and is of no importance. Pneumonia, on the contrary, is a serious complication and the patient should be guarded accordingly. It will not be amiss to give all patients with fractured ribs a sedative cough mixture.

Fractures of the spine involving the neural arch only and without displacement are uncommon. The usual fracture is really a fracture dislocation and is almost invariably accompanied by compression or injury of the cord, caused by bone fragments or hemorrhage. If due to the latter, the resulting paralysis is more gradual. The evidences of cord injury are: (1) profound shock, (2) partial or complete motor and sensory paralysis, corresponding to the point of fracture, (3) loss of reflexes, (4) priapism,

and in serious cases (5) hyperpyrexia. The local manifestations of fracture consist of: (1) displacement, (2) deformity, (3) paralysis of the nerves emerging near to and below the site of compression, (4) altered mobility, (5) pain, (6) tenderness, and usually (7) crepitus. The prognosis is unfavorable, except in those instances in which the cord is uninjured. Fractures above the fourth cervical vertebra are nearly always fatal. In general, the percentage of mortality decreases as the fracture is toward the lower part of the spine. Every precaution should be taken against the development of pneumonia, cystitis and pyelitis.

These patients must be handled and transported with the greatest care and gentleness, lest the cord be further injured. In simple fracture of the cervical region the patient should be put to bed with traction on the head, but if the cord is involved, operative measures must be resorted to within twenty-four hours. All cases of fracture of the spine should be placed on an air or water bed and surrounded with sand bags, and rigid cleanliness must be maintained to avoid the formation of bed-sores. Reduction may be wholly or partially accomplished by (1) anesthesia, extension, and gradual pressure, ending the operation with the application of a plaster-of-Paris jacket or a brace, or (2) by open operation, exposing the injured area to view. The latter is preferable, since it permits of the local effects of the manipulations being observed. The selection of either of these methods will depend upon the existing circumstances in the individual case.

FRACTURES OF THE CLAVICLE.

Fractures of the clavicle are extremely common. In addition to the classic symptoms of fracture, the attitude assumed by the patient is always significant of this injury, since the action of the sternocleidomastoid muscle elevates the inner fragment and inclines the head toward the injured side. Greenstick fractures occur especially in children.

In cases where the absence of deformity is particularly desirable, the patient should be placed upon a firm mattress with a sand bag on the shoulder and the arm bandaged to the side. This position must be maintained until union is firm. If a sharp end of one fragment projects, the skin can be cocainized, incised and the tip removed with bone forceps. In the majority of instances, however, the surgeon will be compelled to select a method of ambulatory treatment, because the cosmetic result is usually of minor importance and the patient will not submit to confinement to bed. Both the Sayre dressing and the Velpeau bandage, or a modification of it, are excellent dressings for these cases. The arm must be fixed to the side with the forearm flexed, so that the finger tips will rest on the opposite shoulder. Pads of lint or cotton are placed in the axilla, between the elbow and chest and under the palm of the hand to avoid excoriation of the skin surfaces. The application of either of these dressings may be preceded by fixing a firm compress at the site of fracture with adhesive plaster.

To apply the Sayre dressing:

1. Fix the arm in the proper position.

2. Cut two strips of adhesive plaster 3 1/2 inches wide and about 2 yards long.

3 Wrap one strip once around the middle of the arm at an exact right angle to its longitudinal axis and pin or stitch it to itself, being careful not to impede the circulation.

4. Bring this strip across the back and completely around the chest.

5. Commence the second strip on the shoulder of the sound side.

6. Carry this strip diagonally across the back, under the elbow on the injured side (cutting a slit for the olecranon process), and across the chest to the starting-point.

To apply a modified Velpeau bandage.

1. Fix the arm in the proper position.

2. Begin a 2 1/2 inch wide muslin bandage on the shoulder of the affected side, bring down the front of the arm, under the elbow, up the back of the arm, across the starting-point on the shoulder, diagonally across the front of the chest, under the opposite axilla, around the back, across the front of the flexed elbow, around the other side of the chest again and back to the starting-point. These turns should be repeated six times, each one just overlapping the previous one, and the dressing completed by circular turns around the chest from below upwards until the entire arm and forearm are concealed by the bandage.

This dressing should be removed and re-applied every five or six days and the skin wiped with alcohol. Union is generally firm at the end of five weeks.

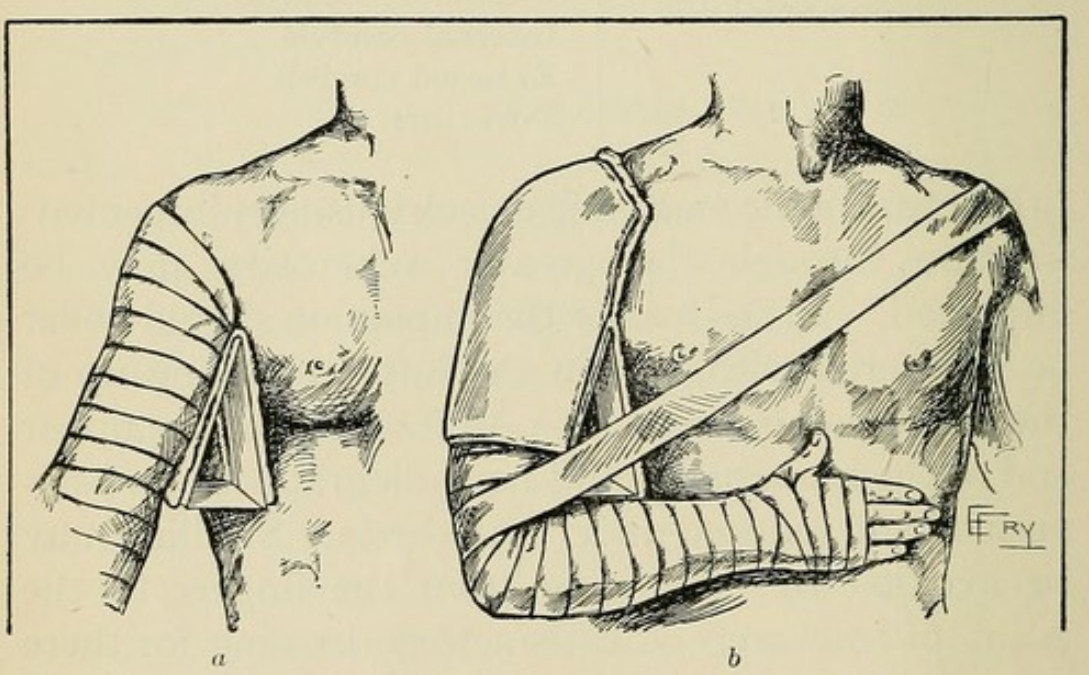
FRACTURES OF THE HUMERUS.

Classification:

Upper epiphysis	Anatomical neck. Surgical neck. Separation of the epiphysis. Through the lesser tuberosity. Through the great tuberosity.
Shaft	
Lower epiphysis	Transverse supracondyloid. Separation of the epiphysis. Internal epicondyle. Internal condyle. External condyle. T-fracture.

Fracture of the anatomical neck is usually impacted; fracture through the greater tuberosity may be impacted. In the former the impaction should never be interfered with, but in the latter breaking up of the impaction is essential. All fractures of the upper end of the humerus should be radiographed, and examined and reduced under anesthesia. Swelling may be avoided by bandaging from the fingers to the point of fracture. A satisfactory dressing for these cases consists of a Λ-shaped pad, extending the entire length of the arm with the apex in the axilla. Position may be maintained by a strip of adhesive plaster carried over the opposite shoulder and reenforced by shoulder cap of plaster of Paris (Fig. 12). The shoulder cap is easily prepared by making a flat piece of several turns of plaster-of-Paris bandages and then moulding to the shoulder and arm. A firm bandage enclosing the injured arm and chest affords additional support. The patient being in a

constantly erect or semi-recumbent position, the wrist should be suspended in a sling, so that the weight of the arm will pull against the fracture. If a new shoulder cap is made at the end of the first week it will fit more snugly than the first one, because of the subsidence of swelling. When the head of the bone become necrotic, complete removal of the diseased bone is more prudent than temporizing with palliative measures.



a *b*

FIG. 12.—*a*, Λ-shaped splint in axilla; *b*, shoulder cap applied and arm in proper position for bandaging.

Injury of the nerves of the arm is often concomitant to fractures of the shaft of the humerus. The musculo-spiral may become involved in the callus formation, evidenced by wrist-drop. Careful examination, accurate diagnosis, exact approximation of the fragments and rigid immobilization are of the utmost importance in these cases. After reduction,

the following method of treatment of fractures of the shaft gives exceedingly satisfactory results:

Apply coaptation splints by wrapping three or four narrow strips of adhesive plaster around five thin strips of wood extending from the axilla to the elbow, cotton being placed underneath. These splints should be securely fixed with a bandage, a shoulder cap applied, the arm bandaged to the side and the wrist placed in a sling. This dressing should be reapplied every week or so, with an assistant making continual traction at each renewal. If the fragments tend to overlap, better results will be obtained by encasing the entire arm in plaster-of-Paris or by using constant extension by means of weights, in a manner similar to that described on p. 68.

Fractures of the lower end of the humerus usually extend into the elbow-joint and the necessity for an exact understanding of the nature of the injury cannot be too strongly emphasized. Entire functional recovery is always doubtful, because complete reduction is often impossible or the callus formation may interfere with proper motion. It should be remembered that with the forearm extended the olecranon process of the ulna and the two condyles of the humerus normally lie in a straight line. Swelling rapidly occurs in all these cases and must be disregarded, as immediate reduction is imperative. Much of the extravasation, however, may be quickly eliminated by bandaging for a few minutes from the fingers to the arm with an elastic bandage. Separation of the epiphysis and supracondyloid fractures are the only two types of fracture of the lower end

of the humerus that require fixation of the forearm at a right angle. This position is best secured by placing an anterior angular splint upon the arm and forearm over a roller bandage. Condyloid fractures may be treated in either the extended or acutely flexed (Jones) position. Unless great care is exercised, "gun-stock" deformity, or loss of the carrying

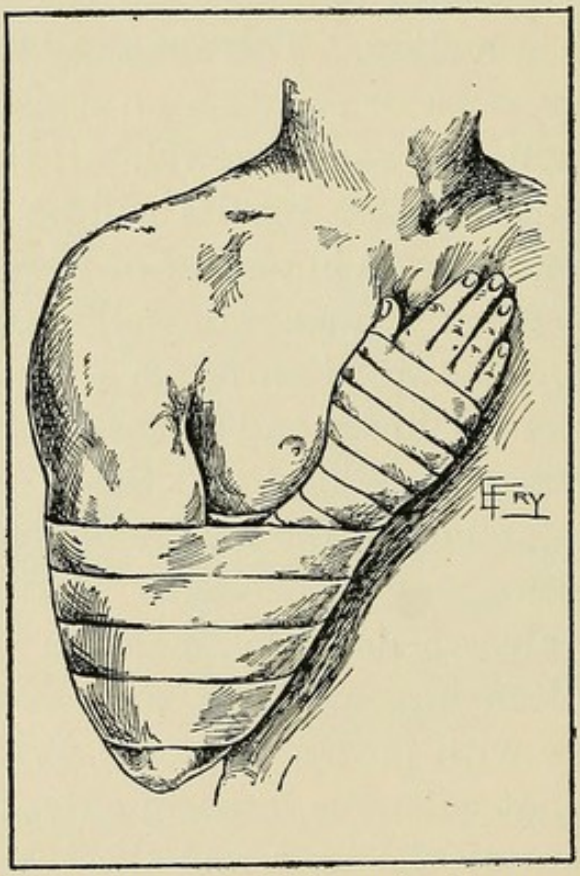


FIG. 13.—Adhesive straps applied to maintain acute flexion of the forearm (Jones' position).

angle not infrequently follows these fractures. The extended position would seem to maintain reduction and preserve the carrying angle better than acute flexion, but on the other hand, when the forearm is flexed, the olecranon process and the tense triceps tendon both splint the line of fracture and this atti-

tude will be much more useful to the patient should ankylosis result. Extensive swelling is an absolute contra-indication to the flexed position, because the pressure therefrom may interfere with the circulation. Acute flexion, then, is the preferable position for condyloid fractures, unless there is great swelling, or reduction of the deformity cannot be satisfactorily maintained. Even if it is necessary to utilize the extended position, the dressings may be removed after a week or two and the forearm flexed under anesthesia. When treating by extention, an iron bar may be fitted to the inside of the sound limb and applied reversed on the inside of the injured limb, to preserve the carrying angle. If the flexed position is decided upon, the proper attitude may be easily maintained by fixing with four of five circular strips of adhesive plaster including both the arm and forearm (Fig. 13). Motion should not be permitted for at least a month.

FRACTURES OF THE FOREARM

Classification:

Radius and Ulna	Complete.
	Incomplete (green-stick).
Radius	Head and neck.
	Separation of the epiphysis.
	Shaft.
	Colles.
	Reversed Colles.
Ulna	Olecranon process.
	Coronoid process.
	Shaft.
	Styloid process.

Precise adjustment of the fragments is essential

when the radius and ulna are both fractured, because of the probability of a synostosis resulting from the agglutination of the callus from each bone. When there is overlapping with shortening, extension must be continual to overcome it. The position of the forearm should be that which will most widely separate the two bones and be the most comfortable for the patient: as a rule, semi-pronation. The exception is when the radius is fractured above the insertion of the pronator radii teres; then the position should be complete supination. The primary roller bandage must be omitted and the splints wider than the forearm in these cases, in order to avoid lateral pressure, which tends to force the bones together; for the same reason, plaster-of-Paris should never be used. An anterior and posterior flat wooden splint are required and they must be accurately padded to fit the irregular surfaces of the forearm. The anterior one is necessarily the shorter and every precaution should be taken that the upper limit does not exert pressure upon the brachial artery where it crosses the elbow-joint. Both splints extend to the knuckles and the sling in which the forearm is carried should uniformly support the entire distance from the elbow to that point.

Fractures of the head and neck and separation of the epiphysis of the radius are not common and are treated in acute flexion. If the functional result is unsatisfactory, excision of the head of the bone may be considered.

Fractures of the shaft of the radius occurring

above the insertion of the pronator radii teres should obviously be treated in a supinated position. If below this point, however, semi-pronation and the plaster-of-Paris splints recommended for Colles' fractures are preferable.

Colles' fractures are transverse fractures of the radius about an inch above the styloid process. The lower fragment is tipped upward and backward and is usually impacted or comminuted. In a reversed Colles' (rare) the deformity is anterior. Radiography is often the only diagnostic method that will positively differentiate a Colles' fracture from a sprain or dislocation of the wrist, unless the silver-fork deformity is pronounced. Permanent deformity and impairment of function will surely follow an incompletely reduced Colles fracture, hence accurate approximation of the fragments is of paramount importance. Reduction is accomplished by fixing the forearm with one hand and gripping the hand of the injured arm with the other, making momentary traction with overextension steadily, and then suddenly flexing the hand. Having secured satisfactory alignment, these fractures do not tend to recur. The results obtained from the following method of treatment are much better than those derived from the time-honored Bond, or pistol-shaped, splint, because the provisional callus is absorbed more rapidly, stiffness is absent, and the function of the wrist joint is unimpaired.

1. With the forearm supinated and the hand adducted, have an assistant support the upper end of

the forearm with one hand and grasp the fingers and palm with the other.

2. Apply a primary roller gauze bandage from the metacarpo-phalangeal joints to the elbow.

3. Mould a plaster-of-Paris splint to the anterior half of the forearm and hand, extending to the knuckles.

4. Mould a posterior splint in the same manner (Fig. 14).

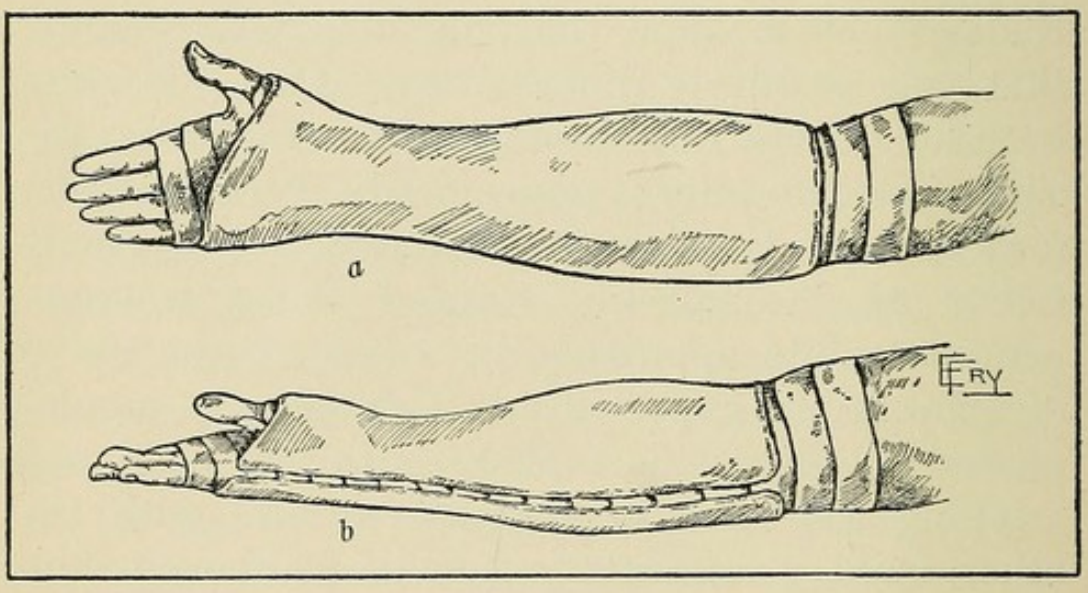


FIG. 14.—Plaster-of-Paris dressing for Colles' fracture. *a*, Anterior splint applied; *b*, both splints applied.

5. When hardened, cut the primary bandage between the splints on both sides.

6. Apply an external bandage.

7. On the second day remove the posterior splint and gently massage the site of fracture for ten minutes, with the finger-tips slightly lubricated.

8. Replace the posterior splint, pronate the arm, remove the anterior splint and massage again.

9. Continue these procedures every two or three

days for two weeks and then begin passive motion at the wrist and fingers.

10. Remove the splints permanently at the end of three weeks.

Reversed Colles' fractures and separations of the epiphysis of the radius may be similarly treated after reduction.

Fractures of the olecranon process of the ulna are followed by the best results when operated upon. If otherwise treated, the forearm should be extended on a well padded splint, a small pad placed above the upper fragment and firmly secured by a strip of adhesive plaster applied obliquely and the whole covered with a muslin bandage. These cases usually terminate in fibrous union when not operated upon but the functional result is uniformly satisfactory. Should the presence of synovial fluid between the fragments seriously interfere with union, it will be necessary to freshen the surfaces of the fragments and suture them together.

The greater number of fractures of the coronoid process of the ulna are found with simultaneous backward dislocations. The existing dislocation must be reduced and the arm put up in acute flexion.

Fractures of the shaft and styloid process of the ulna should be dressed in the same manner as fractures of the shaft of the radius.

FRACTURES OF THE METACARPAL BONES.

In cases where there is but little shortening, the fist may be closed upon a rolled-up bandage and

covered with another bandage. When the shortening is pronounced, extension is preferable:

1. With the forearm and hand pronated, place a gauze pad under the palm of the hand.

2. Apply two lateral strips of adhesive plaster to the finger corresponding to the fractured bone.

3. Place a well padded straight splint under the forearm and hand.

4. Make traction on the adhesive strips and fix them to the under surface of the splint.

5. Place a piece of rubber tubing on each side of the fracture and secure with adhesive plaster.

6. Bandage from the tips of the fingers to the elbow.

FRACTURES OF THE PELVIS.

The gravity and treatment of these injuries depend upon the degree of shock, the integrity of the pelvic girdle, and the extent of injury of the pelvic viscera. The most important complications are: (1) rupture of the bladder, (2) rupture of the deep urethra, (3) laceration of the vagina and rectum, and (4) internal hemorrhage. To determine whether or not the bladder has been ruptured, do a sterile surgical catheterization, empty the bladder of its contents as far as possible, inject a known quantity of a sterile liquid and measure the amount withdrawn. A material difference between the amount injected and the amount withdrawn indicates rupture. The withdrawal of clear urine when catheterizing is corroborative evidence that the bladder is uninjured, whereas the absence of urine or hematuria is sugges-

tive of rupture. If the rupture is intraperitoneal, the symptoms are profound shock, increasing rapidity of the pulse and abdominal tenderness. If extraperitoneal (usually into the space of Retzius), there is slight shock, pain, partial retention of urine and secondary sepsis. Prompt diagnosis is important and immediate laparotomy or perineal section imperative. Rupture of the deep urethra is evidenced by dysuria, strangury, swelling and ecchymosis in the perineum and scrotum due to the extravasation of blood and urine, and if rupture is complete, by retention of urine. In all these cases of fracture the pelvis should be surrounded with broad strips of adhesive plaster and the patient put to bed with sand bags on each side, or slung in a hammock. A pillow must be placed under the knees so that the flexion will relax the abdominal muscles as well as those of the thigh. Injured soft structures should, of course, be repaired and appropriately treated.

FRACTURES OF THE FEMUR.

Classification:

Head (very rare)	
Neck	Intracapsular.
	Extracapsular.
Separation of epiphyses	Upper of femur.
	Great trochanter.
	Lesser trochanter.
	Lower of femur.
Shaft	Upper third.
	Middle third.
	Lower third.
Condyles	Supracondyloid.
	External condyle.
	Internal condyle.

Intracapsular fractures of the neck of the femur are common in the aged, occurring as the result of trivial traumatism, and are usually not impacted. Extracapsular fractures are found more frequently in young adults, due to direct violence and impacted as a rule. There is shortening, eversion, deformity, pain, loss of function, mobility and crepitus (except when there is impaction). It is of far greater importance to distinguish an impacted from a non-impacted fracture of the neck of the femur than it is to differentiate intracapsular and extracapsular types. These cases should never be examined for crepitus under anesthesia as the periosteum may be torn or an impaction broken up, nor should the impaction ever be interfered with, unless the patient is a young healthy adult and the deformity exceptionally pronounced. Gradual increase of shortening during the first day or two indicates liberation of an impaction. The prognosis is grave in old people, because death often ensues from exhaustion or hypostatic pneumonia, consequent to the confinement to bed. Fibrous union frequently results from intracapsular fractures but there is always bony union in extracapsular fractures. Stiffness invariably follows in these cases because of the large amount of provisional callus present. In the aged, regard for the constitutional condition should supersede consideration of the injury. The patient should be treated on a fracture bed, his back supported by a back-rest and the limb steadied with sand bags on both sides. Scrupulous personal cleanliness and good nursing are essential to avoid

the formation of bed-sores. In younger adults the best results are obtained from the use of extension, re-enforced with a well padded side splint extending from the axilla to the foot. This relieves the pain, gives the patient comparative comfort and corrects the eversion.

The treatment of separation of the epiphyses of the femur, great trochanter and lesser trochanter consists of reduction of the deformity by manipulation and fixation of the part with splints or a plaster-of-Paris dressing.

Fractures of the shaft of the femur usually present extreme deformity, because the line of fracture is nearly always oblique and the displacement is exaggerated by the powerful muscular action. Two or three inches of shortening is to be expected. The angular displacement is upward in the upper third, outward in the middle third, and backward in the lower third. These fractures are never impacted and inability to elicit crepitus indicates the presence of soft structures between the fragments. The emergency treatment is important, as these cases should not be transported until the fracture is firmly immobilized. The best emergency dressing consists of coaptation splints, supported by a long axillary splint on the outside and another on the inside reaching from the groin to the foot. These cases should all be treated on a fracture bed by Buck's extension, re-enforced by the foregoing lateral splints. The foot must always be fixed at a right angle and a pad of cotton placed under the tendo Achilles, to prevent pressure upon the heel. Frac-

tures of the middle third are treated by extension in a straight line. For fractures of the upper and lower thirds it is better to use a double inclined plane, with the extension applied above the knee only, to induce relaxation of the muscles responsible for the deformity. A plaster-of-Paris dressing including the entire leg and pelvis has also been recommended and widely employed for fractures of the shaft of the femur. Notwithstanding the fact that by virtue of its solidity this dressing presumes to give perfect immobilization, its weight and uncleanliness are the source of such great discomfort to the patient that it has been unfavorably regarded and discarded by many. In addition to these objectionable features, in the author's experience the results derived from this method of treatment have not been uniformly satisfactory, as they have been when extension was employed. Fractures of the femur in infants and young children are usually green-stick or transverse fractures and constant traction is not as essential as in adults. Moulded splints of pasteboard or binder's board may be applied and secured by a bandage, or both legs may be encased in plaster-of-Paris bandages and suspended vertically by the feet from a crossbar over the bed. Great care should be taken to avoid pressure necrosis of the foot.

FRACTURES OF THE PATELLA.

When due to direct violence, these fractures are often comminuted and there is very little separation of the fragments because the integrity of the

capsule is preserved. Contrariwise, if caused by indirect violence (muscular action), the capsule, as well as the patella itself, is broken; the line of fracture is transverse, displacement is pronounced and overlying soft tissues frequently drop between the fragments. Consequently, bony union is exceptional, unless operative measures are resorted to. Profuse swelling occurs immediately and may be reduced by immobilization and ice, with the leg in the extended position. A relatively large proportion of these cases require operative interference for the correction of the existing pathological conditions and the selection of a conservative or radical method of treatment will necessarily depend upon (1) the amount of separation of the fragments, (2) the integrity of the capsule, (3) the interposition of soft structures and (4) the surgeon's discretion in each individual case. Exposure of the knee-joint, and particularly of its synovial membrane, is an operation of considerable gravity which may even jeopardize the patient's life if performed under difficulties, owing to the rapidity with which infection is absorbed. Conversely, given perfect asepsis and technic followed by primary union, the anatomical and functional results are much better than when the case is treated conservatively. To generalize, it may be said that when crepitus can be elicted and it is possible to approximate the fragments within 1/4 of an inch, a reasonably satisfactory result may be expected from the use of immobilization and splints alone. If crepitation cannot be obtained or it is impossible to approxi-

mate the fragments, incision and suturing are both justifiable and essential. F. D. Gray says, "A badly functionating leg from fracture of the patella, without operation, is near malpractice, while a stiff knee as a result of operative procedure is in the same category."

If operation is deemed unnecessary or inadvisable, the limb must be placed upon a posterior padded straight splint extending from the upper third of the thigh to the lower third of the leg, with a gauze pad under the knee-joint. A small compress is then applied above the upper fragment

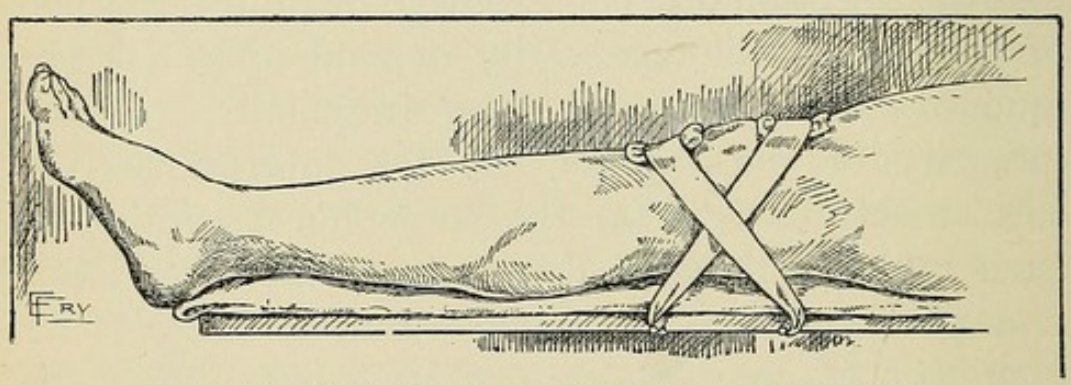


FIG. 15.—Method of treating fracture of the patella.

and secured by means of an oblique strip of adhesive plaster; another compress is fixed below the lower fragment in the same manner, so that the plaster strips cross on each side of the knee-joint (Fig. 15). A convenient means of fastening the plaster strips is to drive two nails or pegs into the posterior splint on each side. The limb must be bandaged from the toes to the upper limit of the splint. If union appears firm at the end of six or seven weeks, passive motion and massage may be cautiously begun.

Should open operation be selected, every detail of preparation and technic must be accorded adequate attention in order that all may contribute to ultimate success and a perfect recovery. There is still some diversity of opinion as to the preferable mode of procedure, but the concensus of opinion seems to be that, as a rule, clearing out the space between the fragments and suturing the capsule and overlying tissues with iodine catgut, under local or general anesthesia, are all that are necessary to effect a cure, although some surgeons consider wiring of the bone fragments essential. Tincture of iodine may be dropped along the skin wound, the knee wrapped in gauze saturated with aluminum acetate solution and the limb bandaged to the posterior splint. These items minimize the danger of infection, restore the injured structures to their normal anatomical relationship, obviate the introduction of non-absorbable suture material and rapidly bring about firm union. Silver wire sutures act as foreign bodies and necrosis of bone frequently follows their use. The patella is refractured more often than any other bone in the body, and the patient should be warned accordingly. Corner, of London, maintains that most refractures in cases treated by operative measures occur in the first year after the original injury, while those cases treated otherwise occur more frequently after the first year

FRACTURES OF THE LEG.

Classification:

Tibia and fibula

- **Tibia**
  - Upper epiphysis.
  - Upper end
    - Oblique.
    - Transverse.
  - Shaft.
  - Lower end
    - Region of the ankle
    - Internal maleolus.
  - Lower epiphysis.
- **Fibula**
  - Upper epiphysis.
  - Upper end.
  - Shaft.
  - Lower end
    - Pott's.
    - External maleolus.
  - Lower epiphysis.

Fractures of both the tibia and fibula are common, often compound and easily diagnosed. When due to direct violence, the line of fracture is usually transverse, both bones being broken at the same level, while if produced by indirect violence, the fractures are usually oblique and seldom occur at the same level. Those due to direct force nearly always become compound within the first week, because of the deficient vascularity of the overlying tissues. The anatomical location of the bones is so superficial that the skin and subcutaneous fascia are unable to withstand the damage inflicted by the traumatism and sloughing with exposure of bone results. The deformity in these cases, however, is slight and easily over-

come and does not tend to recur after reduction. On the contrary, in fractures due to indirect violence the deformity is pronounced and may resist all efforts at reduction. If the displacement is easily reduced, the primary swelling insignificant and no extensive contusion apparent, a plaster-of-Paris dressing encasing the foot, ankle, leg and knee is the most efficient method of treatment, provided the surgeon is constantly on the alert for evidence of pressure and skin necrosis. If the cast is too tight, it will interfere with the circulation, while if it is too loose, it will permit motion and perhaps displacement at the point of fracture. The dressing is best applied over a thin layer of wool and should be removed within six or seven days, unless indicated earlier by pain or swelling of the toes. This affords an opportunity to examine the site of injury and to apply a second cast which invariably fits better than the original one. When there is considerable extravasation or superficial contusion, a wet dressing and padded lateral splints should be applied and the leg placed in a fracture box with a wool pad beneath the tendo Achilles, to avoid pressure on the heel. After the swelling has subsided and the skin has healed, the plaster-of-Paris may be applied as before. If the lines of fracture are very oblique and the overlapping is persistent, it will be necessary to employ the extension apparatus or, as a last resort, perform a subcutaneous tenotomy on the tendo Achilles, to relieve the tension. The foot should be immobilized at a right angle in all these cases.

The treatment of separation of the epiphyses of

the tibia consists of reduction of the displacement and fixation in plaster-of-Paris.

In all fractures of the tibia alone the fibula performs the function of a splint for the broken bone so that the deformity and displacement are not marked. The treatment is practically identical with that employed for simultaneous fracture of both bones, except those of the lower end involving the ankle-joint, which cases demand early passive motion and massage to prevent subsequent ankylosis.

The treatment of separation of the epiphyses of the fibula consists of fixation by splints or a plaster-of-Paris bandage.

Fractures of the upper end and shaft of the fibula are best placed in a fracture box for a week and later encased in plaster-of-Paris.

Fracture of the lower end of the fibula, or Pott's fracture, is a complicated fracture. It usually occurs about 3 inches above the malleolus, rupturing the internal lateral ligament, and wrenching off a spicule of bone from the tibia. There is always a loss of continuity between the foot and malleolus, while if the anterior tibio-fibular ligament has been ruptured and the mortise considerably disturbed, the ankle-joint is widened and the astragalus displaced upward and backward. The foot is invariably everted in all cases of Pott's fracture. The accurate correction of the deformity depends upon the re-establishment of normal anatomical relationship, so that an exact conception of the pathological picture is of the utmost importance. Reduction is best accomplished by firmly grasping the toes and heel, exerting direct down-

ward traction for a minute or two and swinging the foot into position. When there is posterior displacement, the foot must also be pulled forward. If the reduction is correct and complete and proper position maintained, the pain promptly disappears. Inversion of the foot must be slightly exaggerated throughout the treatment of these fractures. The most satisfactory appliance is the Dupuytren splint, which is an internal board splint extending from the knee to below the foot and padded 4 inches thick to just above the malleolus. The foot is now inverted by pulling the toes over with a bandage. In spite of its efficiency, this dressing is often so uncomfortable to the patient that plaster-of-Paris dressings are frequently employed. Whenever the annular ligament is torn and the tibialis posticus is released from its groove, it is good surgery to make an incision, restore the tendon of the tibialis posticus to its normal position and suture the annular ligament.

Fractures of the bones of the foot are usually accompanied by profuse swelling and are treated with the foot extended upon the leg at a right angle, being supported by a well padded splint of binder's board until the swelling subsides. Plaster-of-Paris may then be applied, with a flat-foot plate on the sole of the foot.

CHAPTER V.

COMPOUND FRACTURES AND TRAUMATIC AMPUTATIONS.

Any fracture communicating with the exterior is termed a compound fracture. Single, uncomplicated compound fractures, produced from within outward and with the tip of a fragment only projecting, need not be considered exceptionally important, as the rent in the skin usually heals kindly, converting the fracture into a simple one. On the contrary, compound comminuted fractures with extensive destruction of, or contusion to, the adjacent soft parts, compound fracture dislocations, and gun-shot fractures are grave injuries. The more severe types of compound fractures, in which amputation is partially completed by the inflicting traumatism with destruction of the principal blood supply, may be viewed as traumatic amputations. In these cases the cosmetic and functional results as well as the life of the patient will depend upon:

The surgeon's judgment and skill in each case.

The wishes of the patient and his relatives regarding the proposed and advised surgical procedures.

The patient's health, constitution, age and habits.

The integrity of the circumference of the limb.

The preservation of an adequate blood supply to the injured area and the distal parts.

Proper emergency treatment.

Perfect operative technic.

The degree to which it is possible to restore the injured structures to their normal relationship

Intelligent after-treatment.

Good nursing.

Besides the local conditions, six possible intercurrent occurrences must be considered: shock, tetanus, gangrene, sloughing, secondary hemorrhage and sepsis.

Emergency treatment of compound fractures and traumatic amputations is essentially that of the simple fracture plus an extensively lacerated wound. Hemorrhage from the larger blood-vessels must be immediately controlled, usually requiring either the tourniquet or hemostatic forceps. Applying the tourniquet too far above the upper limit of the injury may seriously embarrass subsequent management of the case, hence the site of constriction should be carefully selected. Large foreign bodies may be removed, provided that it can be done expeditiously, but no bone fragments should be disturbed. The injured part may be returned to its approximate normal position, covered with a heavy wet dressing and bandaged between long splints. The patient should receive a hypodermic injection of morphine and be transported comfortably to the hospital. Even in event of a traumatic amputation these measures are permissible and indicated. It is best to do nothing further for the moment since the injury frequently presents a different aspect when examined in the hospital. *Don't perform amputations on the street.* An ampu-

tation is an operation of no small magnitude, certainly not one to be done on a street corner. There are instances, however, in which it may be necessary to complete a traumatic amputation to release the patient from an enormous weight. When this is done, the severed member should also be transferred to the hospital, because many patients will desire to have it cared for by an undertaker.

Operative Treatment of Compound Fractures and Traumatic Amputations.—Having removed the patient to a hospital or other convenient surroundings, the question presents in severe cases: shall the limb be immediately amputated or shall an effort be made to preserve it, notwithstanding the fact that the patient's life may be jeopardized? The former (primary amputation) may be designated radical treatment, while the latter is obviously conservative. The answer to this question will rest entirely upon the surgeon's judgment after careful consideration of all the facts presenting in the individual case, provided consent of the patient and his relatives to the procedures selected can be obtained. Factors arguing in favor of one or the other methods of dealing with a compound fracture or a traumatic amputation may be tabulated conveniently:

Radical.	*Conservative.*
Constitution poor.	Constitution good.
Age over fifty.	Age under fifty.
Alcoholic habits.	Temperate habits.
More than two-thirds of the circumference of the limb destroyed.	One-third of the circumference of the limb intact.

Main blood supply to the site of injury and the distal parts destroyed.	Adequate blood supply to the site of injury and parts beyond.
Surroundings favoring infection.	Perfect asepsis and antisepsis to the greatest attainable degree.
Proper after-treatment questionable.	Intelligent after-treatment assured.
Good nursing not obtainable.	Good nursing possible.
If a clean amputation is performed, the patient's life will not be jeopardized.	Sepsis always an element of danger but a secondary amputation can be performed at any time.

All the facts at our command, together with the opinion formed, should be cited and the patient must then decide for himself which course shall be pursued in border-line cases. The surgeon, being the better judge of what is required, however, should advise, or even urge the patient as to the course to be taken. Great comminution of bone with extensive destruction of the tissues, two or more compound fractures in the same limb with rupture or severe injury of the principal blood-vessels and nerves, and compound fractures communicating with large joints are usually considered definitely positive indications for primary amputation. In spite of this fact, occasionally it will be possible to save a limb in which even one of these conditions obtains. Unless immediate operation is imperative to save life, it is advisable to afford the patient an opportunity to rally from the shock present before undertaking any operative measures.

For the technic of the various amputations the reader is referred to other works on the subject.

If conservative measures have been selected, all efforts should be made to convert the fracture into a simple one as soon as possible. Despite the kindly appearance of some of these wounds, they must be viewed with suspicion, and all compound fractures, including those of the skull, must be considered and treated from the beginning as though infected.

Conservative Surgery in Compound Fractures and Traumatic Amputations.—To facilitate the necessary manipulations an anesthetic is demanded. Blocking the main nerve trunks with cocaine, as advocated by Crile and others, is the only method of obtaining satisfactory local anesthesia. This also prevents shock to a large extent, as the injection of a 1 per cent. solution into the nerve trunks and periosteum impedes the transmission of excessive nerve impulses. Local anesthesia, *per se*, does not bring about muscular relaxation and its use is consequently restricted to selected cases. In general, narcotization will prove far more satisfactory, and if ether or the nitrous oxide-oxygen combination be used in conjunction with nerve blocking, there need be but slight concern regarding subsequent shock.

Having secured surgical anesthesia, the wound should be lightly packed with sterile tampons to protect the exposed tissues from any additional traumatism incidental to thorough cleansing. The entire part should then be shaved and vigorously scrubbed with a moderately stiff nail brush and tincture of green soap. Following this, the skin may be rapidly sterilized by irrigating it with an iodine solution: 1 dram of the tincture to 8 ounces of

water. We are now working in a surgically clean field.

A sterilized elastic tourniquet applied just above the injured area may be tightened or loosened at will by an assistant, thus controlling hemorrhage that may occur. The tourniquet should not be sufficiently narrow to cut into the skin, nor its application prolonged unduly.

The tampons are extracted and oil or other grease that may have entered the wound is dissolved and quickly removed with swabs impregnated with gasoline or benzine.

The wound should now be sufficiently enlarged longitudinally to permit a thorough inspection of the damaged tissues and the removal with forceps of all visible foreign material. Subsequently, the tissues are mopped, but not scrubbed, with some disinfectant that permeates readily. For this purpose Harrington's solution (hydrargyri chloridi corrosivi gr. xii, acidi hydrochlorici ℥i, alcoholis Oii) is the most efficacious. A compound fracture should not be roughly probed and *the operator should keep his fingers out of the wound.*

If laceration and destruction of tissues are not especially extensive, the damaged areas may be trimmed off and excised, but in the more severe forms the crushed parts are better left until a line of demarcation appears.

Bone fragments must be minutely inspected. Pieces entirely devoid of periosteum should be removed, but no spicule having a periosteal attachment should be disturbed. The fragments may

be gently returned to the most natural position to effect alignment. The query now arises, how can we best maintain proper approximation? Many devices for this purpose are at our command but a good working rule is, the less foreign material introduced the better. Occasionally, fixation of the fragments by uniting the periosteum with absorbable suture material and re-enforced by an external dressing is all that will be required. More often it will be necessary to drill the bones and fasten them together with wires or bone plates. If wire is chosen, the bronze-aluminum variety is the most satisfactory, being stronger and less brittle than either silver or iron wire. Nails and screws passing directly through the bones are not usually effective since they soon loosen and thus fail to fix the fragments firmly until union is complete. Lane's steel bone plates, secured by silver plated screws, are often too rigid and unyielding. The silver bar devised and advocated by Sick comes in lengths with holes for screws and may be cut any length desired. As this is slightly pliable and flexible and is easily removed later through a small incision, it is the most desirable form of bone plate.

Ruptured muscles, nerves and blood-vessels should be accurately approximated and sutured with No. 1 iodine catgut.

Drainage must always be established, preferably at the most dependent portion of the wound; the ordinary cigarette drain or fenestrated rubber tubing will serve this purpose best. If the anterior aspect of the limb is the seat of injury, through-and-through

drainage may be attained through a stab wound on the posterior surface, dividing the deep fascia if needs be.

The wound is now loosely closed with interrupted sutures of silkworm gut, great care being exercised not to constrict (Fig. 16). A heavy wet gauze dressing saturated with aluminum acetate and appropriate splints are applied and the whole placed in a fracture box. If the wound has been contaminated with street dirt or gunpowder, it is advisable

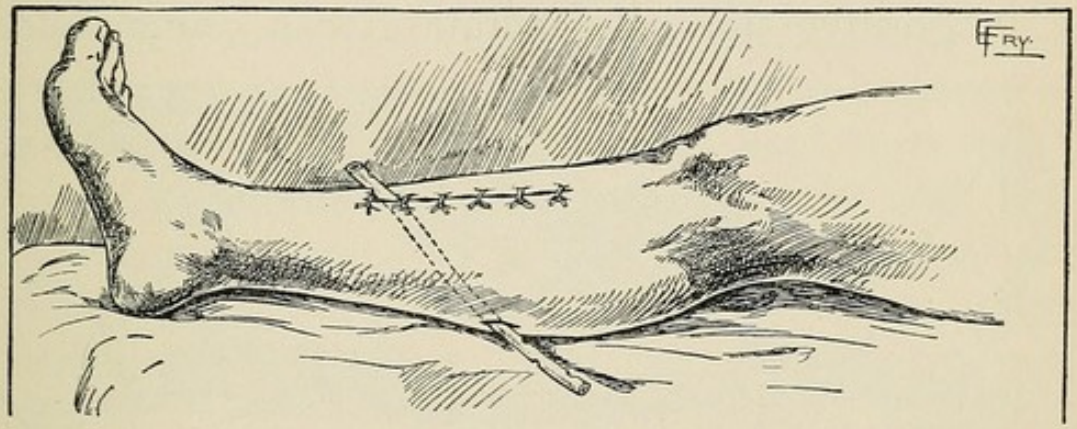


FIG. 16.—Wound sutured with through-and-through drainage established.

to administer an immunizing dose of tetanus antitoxin subcutaneously as a precaution against the development of tetanus.

After-treatment of compound fractures and traumatic amputations consists of free drainage and constant wet dressings. The former may be favored by sprinkling the wet gauze dressing with glycerine from time to time and daily irrigation of the wound and drainage tubes with normal saline solution or a watery solution of iodine. Glycerine is a valuable agent to keep the dressings moist, promote drainage

and hasten sloughing. Continuous irrigation of the entire dressing with normal saline solution, with a rubber sheet under the limb, is a satisfactory manner of maintaining saturation of the dressings. This procedure may be easily accomplished by means of a tin pail suspended above the patient with several small holes in its bottom, through which strips of linen have been forcibly pulled. After the first week, more contusion often becomes apparent and continuous irrigation should be kept up until sloughing ceases.

Progressive tissue degeneration with clamminess

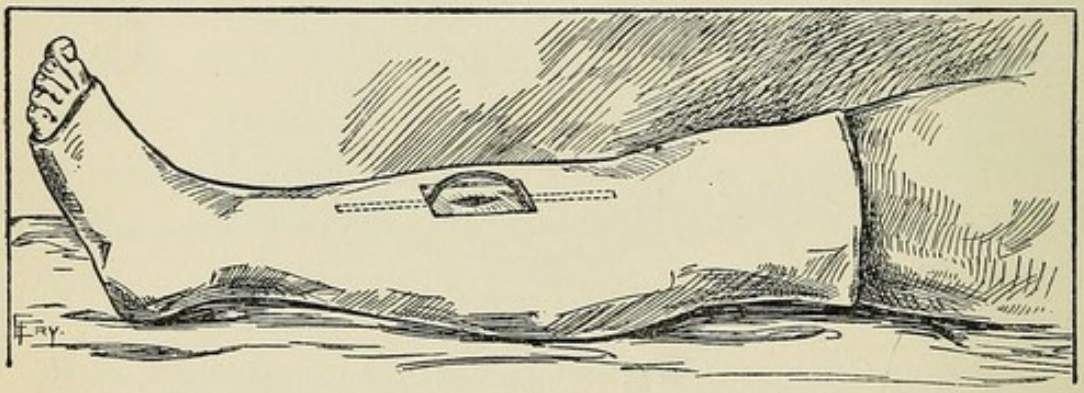


FIG. 17.—Fenestrated plaster-of-Paris cast re-enforced with metal bar.

or gangrene of the distal part or persistent hyperpyrexia denotes that either the blood supply is inadequate or the septic process is beyond control. Further efforts to save the limb are then of no avail and a secondary amputation through sound tissues should be performed.

If, however, the wound is evidently running an aseptic course and the case progresses favorably, the splints should be removed and a fenestrated plaster-of-Paris dressing substituted as soon as sloughing ceases and the danger of sepsis has passed.

It is best to leave an aperture in the cast over the wound area during its application rather than to cut one afterward. The strength of the dressing may be greatly increased by incorporating two (one on each side) metal bars with a curve over the fenestration in the center of the plaster (Fig. 17). The dressings are then continued through the aperture. Surrounding the limb with sand bags serves to steady it and adds greatly to the patient's comfort.

When the granulating areas become visible, equal parts of balsam of Peru and glycerin, poured directly into the wound, will keep the raw surfaces clean and stimulate reparative processes. If the denuded area is extensive, the granulations may be covered with skin-grafts or, almost equally well, with the external membrane found in direct approximation with an egg shell, teased into small pieces under saline solution, placed upon the raw surfaces and covered with lint spread with ichthyol ointment. These dressings must be renewed daily if the egg membrane is used and at each dressing two or three little islands from the previous one will be found adherent. They are excellent foundations for the ultimate process of epithelial regeneration.

Passive motion and massage should be commenced as early as possible and the further recovery of the injured part left to *vis medicatrix naturæ*.

Gratifying success in a large number of cases with the treatment outlined above, as has been the author's experience, will incline the surgeon to adopt a conservative attitude toward most cases of compound fracture or traumatic amputation.

CHAPTER VI.

SEQUELÆ OF FRACTURES.

Complete restoration of function and a perfect cosmetic result depend almost entirely upon intelligent treatment after a fracture has been reduced. Although the Röntgen ray has demonstrated that mathematical reduction of displaced bone fragments is rare, careful attention to details and exact technic will usually assure physiologic restoration with little or no deformity at the injured site. Such a result may be considered eminently satisfactory. *Per contra*, the surgeon's misdirected efforts, carelessness or errors of judgment will eventually become manifest by delayed union, fibrous union, deformed union, refracture, exuberant callous formation, nerve involvement, loss of function (stiffness, muscular atrophy, etc.), rupture and sloughing of the skin and soft parts (converting the injury into a compound fracture), pressure sores, edema, ankylosis or sepsis.

When the reparative process is retarded beyond that period in which normal union should occur, the condition is known as delayed union. Deficiency or slow development of the provisional callus is the etiological factor and may be due to either constitutional or local causes. Among the former may be mentioned syphilis, individual dyscrasia, anemia, senility, etc., and the treatment

is obvious. The chief local condition predisposing to delayed union is imperfect coaptation of the fragments, due to an incorrect diagnosis or improper reduction. Impairment of the circulation may result from constriction when the retentive appliances are too tight or to a reduction of the blood supply occasioned by the necessary ligation of a large artery. Premature motion, active or passive, is frequently a cause and the retentive apparatus should be permitted to remain sufficiently long to allow the callus to solidify and union to become firm, although not long enough to interfere with the use of the limb. At the same sime, too early use of the limb may also delay the union. Operative measures are optional.

Non-union is another term for an ununited fracture, and in the words of Stuart McGuire, "The increasing number of cases of ununited fracture that come to the surgeon, referred by the attending physician, is a clear index of the lack of knowledge possessed by the average doctor with regard to the treatment of fractures." In these cases callus formation is practically absent and the ends of the fragments round off with closure of the medullary canals. The influence of constitutional disturbances in eliminating callus formation is doubtful, with the exception of syphilis. Antisyphilitic treatment for a few days is never detrimental to the patient and often results in remarkable improvement. This, however, must not be construed to mean neglect of the patient's general condition, as the correction of systemic errors is of great importance. The local

causes of non-union are: persistent separation of the fragments, imperfect coaptation with absence of the periosteal bridge, interposition of soft parts, actual loss of bone, impaired vascularity and suppuration. A Röntgen ray examination will disclose many features of the local condition, and the proper interpretation of such an investigation may serve as a guide to the intelligent selection of a particular method of treatment. Persistent separation of the fragments results from either failure to overcome muscular resistance or not accurately approximating the fragments when applying the fixation dressing. This in turn is most frequently due to the omission of anesthesia. If the pathological conditions are present for a sufficiently long time, it will be necessary to resect the ends of the bones, accurately adjust the freshened surfaces and maintain correct position by sutures, wires or some other suitable material. Imperfect coaptation of the bones with absence of the periosteal bridge is often followed by some osseous necrosis which requires operation before satisfactory union occurs. Failure to recognize the interposition of soft structures between the fragments is an inexcusable error and operative measures should be instituted primarily. Inability to elicit crepitus, plus mobility, at the site of fracture should ever arouse the surgeon's suspicions. Actual loss of bone occurs in some instances of compound fractures and the gap is best filled by shortening of the limb or transplantation of bone. Impaired vascularity may be due to disturbances of metabolism or to the destruction of certain blood-

vessels, for example anemia or loss of the main arterial supply or the nutrient artery, when the injury was sustained. Constitutional treatment and Bier's method of elastic constriction to produce hyperemia are usually followed by considerable improvement. Suppuration invariably interferes with the reparative process, but after eliminaton of the infection improvement is rapid. Occasionally, if the suppurative process continues for some time, it will be necessary to expose the seat of fracture and remove the diseased bone. Some surgeons recommend the injection of from five to ten drops of a 10 per cent. solution of zinc chloride between the bones and the administration of lime salts as an aid to organization of callus. Fifty per cent. alcohol has also been used for this purpose. If operative measures are contra-indicated or refused by the patient, mechanical apparatus may be advantageously employed.

Fibrous union is due to failure of the provisional callus to ossify, because the osteoblasts do not functionate properly, although the fibrous portion of the union is satisfactory. Owing to the localities in which fibrous union usually results, such as the patella, olecranon process of the ulna and head of the femur, it is natural to conclude that faulty nutrition is responsible. An open operation is the only recourse and the advisability of this procedure is often questionable, particularly in the upper extremity. Unless the patient is a healthy, well nourished and developed adult, it is better to let

well enough alone than to meddle with an unknown quantity.

Deformed union is the result of faulty adjustment and generally illustrates an error of omission or commission on the part of the surgeon. When due to projection of the tip of one fragment, the skin may be cocainized and incised and the offending spicule removed with bone forceps. If due to poor alignment, resection and re-adjustment are all that can be offered and are almost always followed by pronounced shortening. So before operating for this condition it is wise to hesitate and consider: of how much definite improvement can the patient be assured?

Refracture is uncommon in a normal individual but may occur as the result of too early passive motion (subjecting the broken bone to strain or pressure before union is firm), of violent traumatism and of carelessness on the part of the patient or surgeon. Anemia, inadequate nutrition and diminution of inorganic salts in the economy are predisposing factors and should be corrected by the employment of suitable remedial agents.

Exuberant callus formation is more common in fractures occurring in new-born children. The condition is an extremely painful one but the prognosis is good and the ultimate result satisfactory. Treatment is of no avail, unless the callus mass unites two parallel bones; then a portion may be exsected.

Nerve involvements are produced by injury to the nerve at the time of fracture or, later on, by con-

tusion from undue pressure of splints, bandages, impinging callus, etc., or laceration caused by mobility of the fragments where good approximation is not secured and maintained. Contused and slightly lacerated nerves usually recover while the fracture is knitting, being aided by the enforced rest, warmth of the dressing and natural reparative process. Massage, passive motion, electricity (preferably the galvanic current) and superheated air (400° F.) may hasten a tardy improvement. When the nerve is severely lacerated or divided, operative interference is indicated. To assure a normal physiologic condition the operation should be done as early as possible, suturing the bone as well as the nerve. If the injury is one of long standing, neurorrhaphy will be servicable, although the ulimate recovery will be slow.

Loss of function, not due to nerve injuries, is usually not a matter of great consequence. Removal of the fixation dressing, mobilization, massage and use of the part are sufficient to restore the impaired power. Once union is firm, voluntary action of the neighboring muscles should be encouraged.

The surgeon is seldom responsible for rupture or sloughing of the skin and soft parts within the first week after the fracture, unless the wet dressing has been omitted, since they are generally due to contusion that was not primarily apparent. Faulty alignment and imperfect immobilization may permit the rough margin of a fragment to penetrate the skin and must be corrected when they are causes.

Pressure sores are produced by an ill-fitting plaster

cast or insufficiently padded splints and the surgeon's attention should be attracted by complaint on the part of the patient. Manifestly, the cast or splints must be removed and a new dressing applied.

Edema is always due to failure to equalize the pressure on the distal portion of a limb and may be easily eliminated by the application of a snug bandage.

Ankylosis occurring as a complication of a fracture near a joint is due to peri-articular thickening and disuse of the joint. It is not apt to be permanent, except at the elbow- and knee-joints. The treatment of this condition has been outlined in the chapter on traumatic injuries of joints.

Sepsis occurs after compound fractures only and has been discussed in Chapter V.

CHAPTER VII.

ACUTE PYOGENIC INFECTIONS.

LOCALIZED PYOGENIC INFECTIONS.

An abscess is the formation in tissue of an abnormal cavity containing pus. It is accompanied by softening and sloughing of tissue and, although showing a tendency to encapsulation, the suppurative process will follow the line of least resistance so that the purulent accumulation may either rupture externally or burrow deeper into the soft structures. Thus, if neglected, it may produce a localized but gradually extending cellulitis, septicemia and death. The neighboring lymphatics are soon involved and rapidly transmit the septic process to adjacent lymphatic glands, lymphangitis, lymphadenitis and metastatic abscesses being frequent sequelæ. The symptoms and physical signs of an abscess are too well known to merit enumeration.

A furuncle, or boil, is a circumscribed pyogenic infection of a sebaceous gland or hair follicle, terminating in suppuration with a central necrotic mass. Because of its superficial location a furuncle will eventually rupture through the skin spontaneously and thus establish drainage. The infection is usually self-limited, since nature affords relief before the suppuration progresses to any great extent. In other respects a furuncle differs but little from an abscess.

A carbuncle is an acute phlegmonous inflammation of the skin and subcutaneous tissues with multiple foci of necrosis. The cellular tissues slough extensively, the skin becomes indurated and dusky and numerous small perforations soon appear. Carbuncles nearly always occur on the neck or back in adults with some constitutional disturbance, notably diabetes.

Cellulitis is an inflammation of the loose connective tissue, invariably of bacterial origin, due to (1) a severe contusion or (2) an infected wound. Unless relieved promptly, suppuration is inevitable. The immediate complications are (1) extensive destruction of tissue, (2) suppurative teno-synovitis, (3) lymphangitis and (4) lymphadenitis. When treatment is neglected or misdirected, the infection tends to follow the fascia and tendon sheaths, subsequently attacking the bone with resulting necrosis. The lymphatics rapidly transmit the infection upward, toxines are absorbed and septicemia and death ensue. The rapidity with which a cellular suppuration will sometimes spread is remarkable. The severity of the affection in a given instance is, of course, largely influenced by the virulence of the micro-organisms responsible for the infection and the patient's resistance to bacterial invasion, and the subsequent toxemia. The most reliable index of the patient's antagonistic power is the leucocytosis developed. The phenomena denoting a gradually spreading cellulitis are: (1) history of an injury (contusion or infection), (2) swelling, (3) skin cyanotic and edematous (indicating partial circulatory stasis), (4) pain,

(5) tenderness on pressure, (6) local heat, (7) restricted mobility of the part, (8) red and indurated superficial lymphatics, (9) upper limit of the involved area constantly extending, and (10) evidences of toxic absorption (chills, pyrexia, increasing rapidity of the pulse, etc.).

In all infectious conditions the presence of constitutional disorders is of paramount importance. For example, furunculosis (intermittent outbreaks of boils) and carbuncles are frequently associated with diabetes, nephritis, plethora, etc., and consequently a thorough urinalysis should be made in all these cases. Obviously, the correction of systemic errors or disturbances will increase the patient's resistance to bacteriemia and toxemia.

Treatment of Localized Pyogenic Infections.—The cardinal principle in the treatment of all localized collections of pus is to establish drainage immediately. Additional measures are also frequently indicated but without effecting a point of exit for the pus and maintaining free drainage the integrity of the tissues still uninvolved and even the patient's life may be jeopardized. Every effort should be made to assist the tissues in their effort to mitigate bacterial activity.

Poultices, devised by our grandmothers, are mentioned only to be condemned. Nothing will be gained by waiting for "pointing" except bacterial multiplication. Even though a poultice may encourage spontaneous rupture of the skin, it will be necessary to enlarge the aperture and treat in the usual manner. On the contrary, cold wet dressings

may be of service in the early inflammatory stages by relieving local congestion. The application of antiseptic solutions (bichloride of mercury and carbolic acid usually being favored) with the hope of exerting destructive influence on the pyogenic organisms is absurd, since no antiseptic can penetrate the unbroken skin sufficiently to restrict germ growth. Were this fond hope realized, the patient would be poisoned by vascular absorption. Carbolic dressings are particularly dangerous because of the frequency with which poorly nourished tissues become gangrenous from its constant use. Benefit is derived from dressings saturated with plain water or some evaporating lotion, such as equal parts of alcohol and witch hazel, simply because the evaporation assists the restoration of the normal vascular equilibrium. In exceptional instances the necessity for incision may thus be obviated.

As in all other surgical procedures, the overlying and adjacent skin should be cleansed and the operator's hands should be clean. This may seem a superfluous injunction, yet carelessness is the rule rather than the exception.

Anesthesia of the site of incision should be secured and for this purpose the ethyl chloride spray is ideal. The container is the only apparatus required, cutaneous anesthesia and temporary ischemia are easily and quickly obtained, there is no additional tension on the inflamed tissues and this method of freezing is not followed by sloughing.

All incisions are preferably made parallel with the course of the blood-vessels and the longitudinal

axis of the part. By so doing profuse hemorrhage will be avoided and all possible sources of nutrition preserved. When the pus collection is small, a single incision should be made directly over the center of the tumefaction and need be large enough only to allow free vent for the pus and the introduction of a small drain. Abscesses situated near large blood-vessels, such as axillary abscesses, are best opened by incising the skin, pushing in a pair of closed hemostatic forceps and withdrawing them open. In large carbuncles and extensive cellulitis the aperture must be larger or multiple incisions may be made at various points to permit the establishment of several channels of through-and-through drainage. In such instances some of the deeper dense tissues should also be divided, if the infection appears to extend inward. Although, as a rule, incisions are not required until pus has formed, early incision is often necessary to relieve tension and the strangulated circulation, thus preventing the extensive sloughing that follows steady intense pressure. It is therefore unwise to always wait for fluctuation before incising. When the life of healthy tissue is endangered by a virulent suppurative process, such as a cellulitis due to the staphylococcus pyogenes albus, it is best to extend the incision into the sound region. The length and depth of the wounds are of secondary consideration. When the cosmetic results are of special importance, much can be accomplished in cases of circumscribed pus collections with a small incision followed by active hyperemia. The latter may be obtained

by small sterile Bier suction cups, the rims being lubricated with petrolatum, applied in séances of five minutes each with three minute intervals of rest for forty-five minutes. Much has also been claimed for passive hyperemia as a preventive of suppuration and as an aid in limiting the infectious process, being used in conjunction with drainage, after the suppuration has actually occurred.

After all incisions, the pus should be expressed by exerting gentle but firm pressure over the surrounding skin and local bleeding should be encouraged for a few minutes. General blood-letting is contra-indicated, since it depresses the patient's vitality and thus lowers his resistance to septic infection. Should the hemorrhage appear excessive or be unduly prolonged, it may easily be controlled by packing the cavity temporarily with gauze strips wrung out in hot water. Bands of fascia and tendon sheaths must be carefully investigated and longitudinally incised, if necessary. A probe should be passed down to the subjacent bone to exclude periosteal involvement and necrosis. When a felon exists, it should be incised down to the bone.

Curettage of the cavity after pus evacuation is advocated and practised by many surgeons but is advisable in small abscesses and carbuncles only. In all other conditions it is better to wait for the slough to separate, in order to avoid injuring areas of normal tissue. In carbuncles the undermined skin areas should be excised before curetting.

To secure sterilization, check hemorrhage, hasten sloughing and stimulate granulation, the cavity

should be filled with tincture of iodine with an ordinary medicine dropper. This should be permitted to remain undisturbed for a few minutes before introducing a drain. Pure carbolic acid has also been used for this purpose but its use is best restricted to carbuncles. Some surgeons practise hypodermic injections of powerful antiseptic solu-

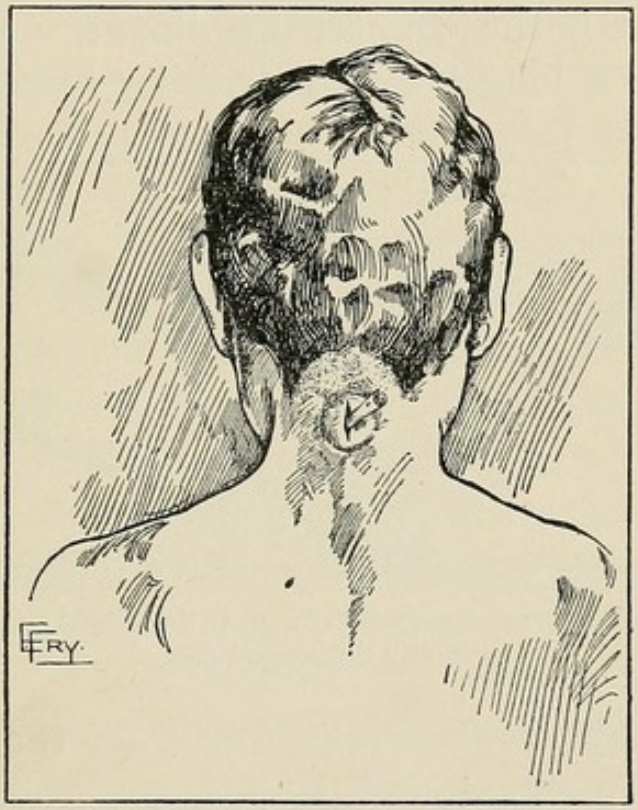


FIG. 18.—Furuncle on the neck properly incised and drained with gutta percha tissue.

tions into or near the affected region. These injections may limit the inflammation, yet they possess the disadvantage of being extremely painful and constitutional poisoning may result therefrom.

All infected cavities must be drained. Drainage does not mean plugging the opening with gauze, but maintaining a free flow of discharge, be it simple

exudate or pus. Gauze, plain or medicated, does not drain, as is invariably demonstrated by the gush of pent up pus that follows the removal of a gauze wick. The most satisfactory drain for a small aperture is a little roll of gutta-percha tissue (Fig. 18). For larger openings and extensive sloughing areas the fenestrated rubber tube is the drain *par excellence*. When through-and-through drainage is desired, the counter-openings are best made by pushing a long handled dressing forceps under-

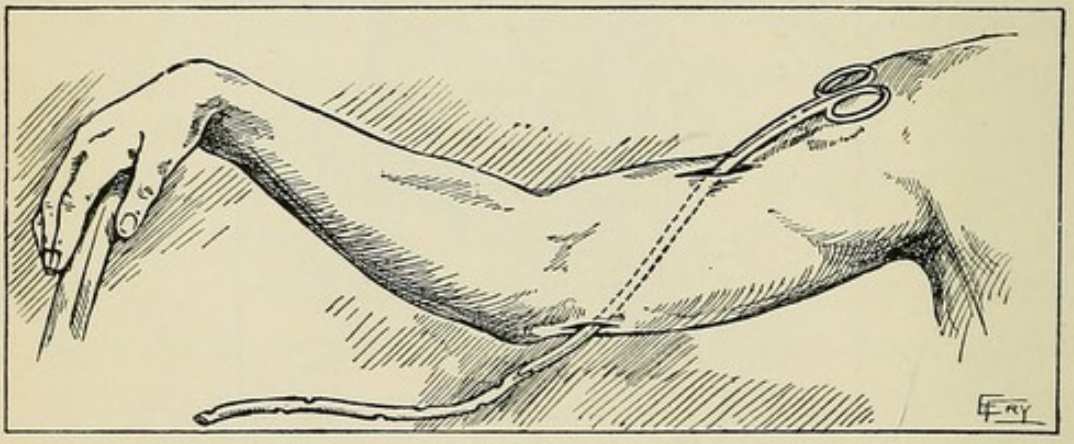


FIG. 19.—Dressing forceps pushed through incision and counter-opening, grasping drainage tube.

neath the skin to the opposite side of the part and incising over the tip. The jaws are then opened, grasp one end of the tube and withdrawn, thus pulling the tube into position (Fig. 19). Peple has recently devised a serviceable drain, consisting of a split rubber tube into which are sewed several folds of rubber dam. This drain possesses capillarity, does not become clogged and drains along its entire length. Its single objection is the impossibility of irrigation through the tube, hence it cannot be used when sloughing is extensive.

A voluminous wet dressing should cover all infected parts and extend well beyond in every direction. Plain water, normal saline solution, aluminum acetate solution, alcohol and witch hazel or Burrow's solution may be used for soaking the gauze. The particular agent selected is of minor importance, provided the dressing is kept constantly wet. When the patient is confined to bed with a large surface requiring attention, it is well to employ continuous irrigation. Saturating the dressings with a hot watery solution of 1 per cent. sodium citrate and 4 per cent. sodium chloride, as recently advocated by Wright, is an excellent method of promoting drainage. The solution is hypertonic and stimulates exudation by osmosis. The sodium citrate prevents coagulation and scab formation so that the cavity will drain through a comparatively small incision. The skin must be smeared with vaseline or some other emollient to prevent the dermatitis that might result from its continuous application. This solution is contra-indicated if there is persistent oozing and should not be used in clean cases where profuse drainage is not essential. The treatment should never be prolonged more than three days or healing will be markedly retarded.

The presence or absence of systemic disturbances in connection with pyogenic infections should be determined and support will be required to overcome the debilitating effect of the septic element. Iron, arsenic and sulphur, preceded by a calomel purge, are most often used. The administration of quarter-grain doses of calcium sulphide every three hours

for a few days exercises a beneficial effect and aids in preventing the recurrence of carbuncles and furuncles.

After-treatment of Localized Pyogenic Infections.—All suppurating cases should be dressed daily or even more often, until pus formation ceases and granulation commences. In limited infections the drain should be removed and the sloughs expressed. The cavity is again filled with pure tincture of iodine, a new drain inserted and a fresh wet dressing applied. In more extensive infections the drainage tubes should be irrigated with hydrogen peroxide, followed by the usual watery solution of iodine. Shreds of slough should be excised and, if the destruction of tissue progresses, new openings may be made and additional drainage tubes inserted. At each dressing the skin should be cleansed with 70 per cent. alcohol. As the quantity of pus diminishes, the tubes may be gradually shortened and withdrawn. When the suppurative process has entirely disappeared, the pockets and cavities should be loosely stuffed with plain gauze. Applications of the U. S. P. boric acid ointment or 10 per cent. ichthyol are of use in the after-treatment of boils and carbuncles after the wet dressings are discontinued.

SYSTEMIC PYOGENIC INFECTIONS.

Systemic infections are sequelæ resulting from local bacterial invasions, due to the absorption of the toxines and endotoxines of the invading bacteria, and are characterized by grave constitutional disturbances. The intoxication may occur as a sapremia,

bacteriemia, septicemia, toxemia or pyemia, but it is almost unnecessary to make a minute distinction, since the manifestations of the various types are similar in almost every respect and the treatment is much the same. The clinical phenomena evidencing a constitutional intoxication are: presence of local suppuration, hyperpyrexia (more elevation in the evening), chills, flushed cheeks, increased pulse rate, digestive disturbances, sweating, prostration, urinary changes and sometimes delirium or coma. Any or all of these manifestations may be present. Pyemia is characterized by the formation of metastatic abscesses. Unless efficient treatment is instituted promptly, death soon occurs.

Treatment of systemic infections consists of (1) removal of the source of absorption and disinfection of what cannot be removed, (2) serotherapy, (3) promoting elimination by stimulating the emunctories, and (4) combating the constitutional symptoms by supporting the patient's vitality with nourishing foods and suitable tonics.

The first is obtained by emptying and disinfecting all the original foci of suppuration, as described in the previous paragraphs of this chapter. This in itself often suffices to cause the disappearance of toxic symptoms, by arresting the propagation of bacteria. In pyemia, if a suppurative lymphadenitis exists, the glands should be completely excised.

Serum-therapy is now being accorded considerable attention as a method of combating profound toxemias and good results are often obtained from the use of antitoxines and vaccines, particularly in strepto-

coccus and staphylococcus infections. When the services of a capable pathologist can be secured and the necessary facilities are at hand, it is better to manufacture an autogenous vaccine than to employ a stock preparation. This will also avoid any possible error that might be made regarding the identity of the organism responsible for the infection.

The excretory organs must be kept active to promote elimination. Drugs administered *per os* are to be avoided, as they may further irritate the already disturbed stomach. Hydrotherapy has distinct value but hot packs are contra-indicated because they tend to depress the patient's limited vitality. The patient must be given absolute rest in bed and surrounded with hot-water bags to induce perspiration. Physiologic saline solution, given hypodermatically, as an enema or intravenously, markedly aids elimination, as well as serving as a circulatory stimulant. The author has derived extremely satisfactory results from an enema consisting of 4 ounces of magnesium sulphate dissolved in a pint of cool water (70° F.), repeated every two hours until improvement is pronounced. Rapid elimination of toxines is brought about by the osmotic action of this solution, which at the same time causes free catharsis. The low temperature serves to reduce pyrexia. Persistent vomiting is not rare and can be relieved by gastric lavage.

The food should be nourishing and easily digested. Coffee, alcoholic stimulants, broths and milk will usually suffice. When the stomach has been washed out, the patient may be fed *per rectum* for a few

days. Later, a few well selected tonics may be cautiously introduced. The tincture of the chloride of iron and the freshly made elixir of iron, quinine and strychnine are excellent preparations. The cardio-vascular depression, which is always present to a variable degree, may be ameliorated by inhalations of oxygen.

SPECIAL INFECTIONS.

Among the special forms of infection frequently encountered may be mentioned erysipelas, tetanus, anthrax, malignant edema and glanders. None of these are true pyogenic infections, yet for the sake of convenience the first two will be considered here.

Erysipelas has been clinically subdivided into phlegmonous, facial and the erysipelatoid lymphangitis of Rosenbach. There exists some diversity of opinion regarding the exact identity of the organism causing erysipelas but it is universally acknowledged that it is due to a streptococcus invasion. The three disease types are practically alike except for the variation in the intensity of the infection. The phlegmonous form is a severe one, the facial milder and the erysipelatoid lymphangitis is a condition found almost exclusively on the hands. The subjective and objective signs of erysipelas are too well known to require reiteration; the disease may run a benign or malignant course, depending upon the virulence of the bacterial invasion.

All cases of erysipelas should be completely isolated, as a mild infection in one patient may be transmitted

to another in a profoundly septic form. Attendants should wear rubber gloves for self-protection.

Local applications of suitable medicaments rapidly check the spread of the disease and hasten resolution, so that the painful measures often recommended, such as sacrification and intradermal injections, are usually unnecessary. The three most efficient remedial agents are iodine, ichthyol and carbolic acid. Irrespective of the agent selected, the local applications must always extend half an inch to an inch beyond the margin of the eruption. Iodine is best applied in the form of the tincture; ichthyol, 2 drams dissolved in 1 ounce each of alcohol and ether; and carbolic, painted on the surface until whitened and followed by the liberal use of alcohol.

Constitutional treatment is of the utmost importance in these cases, as the patient's powers of resistance are poor. The régime to be followed is essentially the same as that in systemic infections.

For some reason, as yet not satisfactorily explained, an attack of erysipelas occasionally exerts a favorable and curative influence on certain intercurrent conditions. For example, various writers have reported that sarcomata have entirely disappeared after an attack of erysipelas. In an attempt to produce these results, sarcomatous patients have been intentionally inoculated with the toxines of the streptococcus of erysipelas and a certain degree of sucess has been claimed by some authors. To increase the potency of the preparation, the toxines of the bacillus prodigiosus are added, this product being known as Coley fluid.

Tetanus is an infectious disease due to the bacillus tetani, characterized by violent and persistent tonic spasms of the voluntary muscles, particularly those of the lower jaw, and sometimes accompanied by local paralysis. Distinct intermittent exacerbations are usually present. The infection originates in wounds, especially those of the extremities, and is due, as a rule, to contamination with actual dirt. Unlike the ordinary pyogenic infections, the invasion of bacilli tetani does not interfere with primary union, hence the initial symptoms are not local but general. In man, the rigidity usually begins in the masseter and posterior cervical muscles, progressing downward from the head, and may be followed by persistent opisthotonos. The toxines are intensely virulent and the period of incubation may vary from one to twenty days. Upon the duration of the period of incubation, the prognosis may be safely based. In cases exhibiting a short period of incubation (one to eight days) a fatal termination may be anticipated, while in the milder cases (twelve to twenty days) recovery may be expected, in spite of the fact that the course of the disease is apt to be prolonged. Cases developing between the eighth and twelfth days after the injury may terminate in either recovery or death and are undoubtedly influenced to a greater extent by appropriate remedial measures than are those of the other two classes. These statements are verified by experience and careful investigation of the records of a large number of cases of tetanus, occurring before as well as after the introduction of tetanus

antitoxine as a curative agent. The symptomatology of tetanus is distinctive and will not be elaborated here.

The most efficient method of treatment is prophylaxis, which consists of thorough disinfection of all wounds, removal of sloughs, foreign bodies and other extraneous matter, and drainage. All cases of gunshot wounds and those contaminated with street dirt, especially the dirt from asphalt pavements, should be given a prophylactic subcutaneous injection of from 10 to 20 c.c. of tetanus antitoxine just above the wound. When the tetanic condition has once become established, the antitoxine must be administered within twenty-four hours to be of material service. It should be generously used: 20 c.c. injected along the nerve sheaths above the site of injury, 10 c.c. thrown into the cerebro-spinal axis (usually a subdural injection) and 20 c.c. used for moistening the dressing covering the wound. The injections may be repeated every twelve hours if necessary and the patient's condition permits. Although the antitoxine usually has but little effect upon those virulent cases with a short incubation period, its use should not be discouraged. Needless to say, the antitoxine should always be used reasonably fresh.

Some surgeons have employed a solution of magnesium sulphate as an antitetanic remedy with marked success in many instances. Like antitoxine, it is administered by injection into the cerebro-spinal axis. However, it should not be accepted as a substitute for antitoxine.

To palliate the paroxysmal exacerbations, antispasmodics and hypnotics are useful. Chloroform inhalations and 5-grain doses of chloretone have the most favorable action, especially if re-enforced with quarter-grain hypodermic doses of morphine. The patient should be confined to bed in a dark room and fed through a soft-rubber catheter passed into the pharynx through the nose. Catheterization and enemata are usually necessary to relieve the retention of urine and feces. There can be no objection to the adoption of other therapeutic measures that may be required.

CHAPTER VIII.

EFFECTS OF INTENSE HEAT AND COLD.

BURNS.

Classification:

Extent	1. First degree: simple hyperemia. 2. Second degree: dermatitis with vesication. 3. Third degree: eschars, gangrene and carbonization, involving subcutaneous structures.
Causative factors	1. Contact with flames and intense heat. 2. Contact with hot liquids or steam (scalds). 3. Contact with electric currents. 4. Prolonged exposure to solar rays. 5. Lightning stroke. 6. Röntgen ray burns. 7. Chemical (concentrated acids and caustic alkalies).

The extent of the destruction of tissue depends upon the temperature of the radiant heat, duration of contact, superficial diffusion of the heated object or fluid, and density of the area burned. In severe cases, the constitutional effects are pronounced and the alleviation of these associated conditions is of even more importance than the local treatment of the burn itself. Shock and nephritis are almost constant concomitant factors, and suppuration, sepsis and secondary hemorrhage not infrequent ones. The symptoms may be: (1) pain, (2) restlessness, (3) frequent micturition, (4) cold extremi-

ties, (5) small and rapid pulse, (6) persistent thirst, (7) edema, (8) prostration, (9) collapse and (10) unconsciousness. If a large surface is burned or scalded, the excretory function of the skin is markedly impaired and it is necessary for the kidneys to compensate for the sudden diminution in toxic elimination by the skin. Being often unable to immediately cope with this emergency, congestion and nephritis soon follow. In fact, it has been stated, and confirmed by experience, that even burns of the first or second degree extending over one-third or more of the body surface interfere with the excretory function of the skin to such an extent that these cases rarely recover; the majority die of shock within twenty-four hours. Burns of the third degree are also influenced by the extent of the region destroyed and the depth to which the tissues are disorganized. Although the patient may frequently lose consciousness and later regain his mentality, instantaneous death, from the arrest of cardiac and respiratory action, is a common occurrence from contact with heavily charged electric wires and lightning. Traumatic neuroses occasionally follow these injuries. An *x*-ray burn is a peculiar lesion in itself, characterized by a stubborn dermatitis, ulceration of the skin, and painful and tedious recovery. If extensive, amputation may be necessary. A number of deaths have occurred as the result of frequent or prolonged exposure to the *x*-ray, but with universal recognition of its dangers, improved technic and restriction of its use to those skilled in its application, these injuries are now infrequently

observed and before long should become a rarity. The mortality from burns is particularly high in infants and young children.

Local Treatment of Burns.—The local applications appropriate in a given instance will vary according to the severity and extent of the burn.

The pain incident to burns of the first degree is immediately relieved by applications of a saturated solution of either sodium bicarbonate or picric acid. Several layers of gauze should be saturated with the solution and wrapped around the burned area. Later, dressings of petroleum ointment may be substituted. Since burns of the first degree leave no scar, they are of relatively small consequence. Burns due to exposure to the sun are best treated with applications of bicarbonate of soda solution, followed by some simple emollient, such as vaseline or almond oil.

Burns of the second degree are nearly always accompanied by the formation of vesicles or blebs and to avoid injuring them the clothing should be carefully cut away. Exposure to air is to be avoided and one area should be dressed before another is uncovered. Asepsis will thus be maintained and a rapid uncomplicated recovery will ensue. The surface may be cleansed by gentle irrigation with warm sterile water and the belbs punctured at their base with a sterile needle to allow the extravasated serum to escape. The epidermis, however, should not be disturbed or removed, since it protects the denuded papillæ. Burns of this class are often infected through careless technic and asepsis is im-

portant. There exists some difference of opinion regarding the applications to be employed in these cases. Various writers have claimed good results from the sole use of either dusting powders, emollients or wet dressings. All are of value under certain conditions but no single one should be utilized to the exclusion of the others. Given, a recent uninfected burn with preservation of the epidermis, a mixture of one part acetanilid and three parts boric acid, dusted in a thick layer over the burn and covered with gauze, will prevent infection and promote rapid recovery. These dressings should be left undisturbed as long as possible. If the burn is extensive and the belbs have already ruptured, leaving numerous raw surfaces, carron oil (a mixture of equal parts of lime water and raw linseed oil) will relieve the pain and soothe the irritation following the contact with air. This is the remedy most often employed in emergency work and is indeed an excellent temporary dressing. Later on, the margins of the belbs may be trimmed, extraneous material removed and the denuded surfaces carefully dried by sponging with sterile gauze and mopping with tincture of iodine, and a 10 per cent. ointment of boric acid applied. A 5 per cent. ointment of ichthyol is also frequently used but is inferior to the boric acid, except in the presence of inflammation. When epidermization begins, the U. S. P. ointment of zinc oxide should be substituted. If a burn does not present for treatment until considerable time has elapsed and the area is already infected, wet dressings are of service. Fomentations of Thiersch's

solution[1] or normal saline solution should be constantly applied until the granulations become healthy, and then followed by the boric acid ointment. The indications for redressing burns are: (1) rise of temperature, (2) local pain, (3) odor and (4) soiled dressings. The treatment of burns by omitting all coverings except a dusting powder, thereby constantly exposing the surfaces to the air, and frequent mopping of the extruded serum has been recently advocated. The results in the few cases in which the author has employed this method, however, have not been encouraging.

Burns of the third degree are always dangerous injuries because subsequent sloughing is profuse and complications are the rule. Electric burns are almost invariably of this class and are characterized by absence of pain and slow healing. While combating the constitutional effects and complications is of paramount importance, this dictum must not be construed to excuse neglect of the local treatment. The objective points are to secure rapid separation of the slough and prevent sepsis. The constant warm bath (100° F.) of normal saline solution, which has been more widely employed abroad than in this country, is an efficient method of treatment. It should be continued until healthy granulations appear. Dressings of equal parts of balsam of Peru and glycerine likewise hasten separation of the slough in restricted areas. The dressings should be changed

[1] Thiersch's solution:

Salicylic acid	℥ ss
Boric acid	℥ iii
Sterile water	O ii

daily and the wound irrigated with hydrogen peroxide. As the shreds of necrotic tissue loosen, they may be excised with scissors. Iodine is then dropped into the wound to cleanse it. When granulation begins, the surfaces should be touched with a 1 per cent. solution of copper sulphate, to stimulate the regeneration of tissue. As the healthy tissue approaches the surface, healing will be accelerated and cicatricial contraction obviated by employing Thiersch's skin-grafts or transplanting skin-flaps. In addition, the position which puts the surface of the part on the stretch will tend to diminish the skin deformity by temporarily enlarging the surface.

Burns due to chemical agents, such as strong acids and alkalies, must be treated by the chemical antidote for that which has produced the excoriation. Weak alkalies are indicated in burns due to acids, and *vice versa*.

X-ray burns, if painful and extensive, usually require excision of the ulcerated areas or amputation, as they are absolutely resistant to ordinary methods of treatment. Curettage of the ulcers, followed by skin-grafting, will occasionally cure.

Obviously, any burn sufficiently severe to destroy the blood supply and bone of a part necessitates amputation.

Treatment of the Constitutional Effects and Complications of Burns.—In all cases of burns the indications are: (1) to relieve pain and overcome shock, (2) to guard against visceral congestion, and (3) to counteract the exhaustion incident to continual pain and suffering or sepsis.

All cases of extensive burns should immediately receive sufficient morphine hypodermatically to relieve pain. One quarter of a grain usually alleviates pain, supports the heart, and quiets the patient, but it may be repeated as often as necessary. It should not be combined with atropine as the latter arrests glandular activity. The patient should be placed in bed, surrounded with hot water bottles and kept absolutely quiet. All severe burns are accompanied by marked shock and every effort should be made to establish reaction as soon as possible. For details, the reader is referred to the chapter on surgical shock. In cases of electric shock, artificial respiration and hypodermic injections of strychnine and atropine should be employed.

Inflammation of any of the viscera may occur and give rise to alarming symptoms. Of the involvements, renal congestion appears first and is evidenced by albuminuria, as well as the other urinary findings of nephritis. The most efficient remedy in such conditions is 2 drams of liquor ammonii acetatis, administered in a half a glass of ice water every two hours. This relieves thirst, promotes diuresis and depletes the congestion. Constipation is not unusual and is ordinarily relieved by some simple laxative, such as castor oil. Inflammation and ulceration of the gastro-intestinal mucosa is frequently but another manifestation of visceral congestion and may be followed by diarrhea, perforation and death. In such cases, opium, gallic acid, bismuth and other intestinal astringents are serviceable.

Many patients who survive the initial shock accompanying a severe burn will die later of exhaustion. For instance, it is not unusual for a case of third degree electric burn of the back to apparently progress favorably for a week or more and then slowly die of exhaustion. The indications are: to (1) allay pain with repeated hypodermic injections of morphine, (2) maintain asepsis of the injured area, (3) hasten sloughing and repair, (4) guard against complications, such as nephritis, pneumonia, vomiting, diarrhea and cerebral congestion, and (5) support the patient's vitality with a nutritive diet and suitable tonics.

SUNSTROKE.

While not properly within the domain of surgery, insolation and heat exhaustion so frequently present as emergencies, particularly to the ambulance surgeon, that their consideration here may not be amiss. It is of the utmost importance to differentiate these two varieties of sunstroke, as the former represents a disturbance of the heat regulating centers due to the toxemia from the excessive heat, while the latter depends on a vasomotor paralysis with marked circulatory disturbances in the brain and body surface. The treatment appropriate for one is practically that which is contra-indicated for the other. To distinguish between the two, the following phenomena should be observed:

Insolation.	*Heat Exhaustion.*
Patient insensible.	Patient dazed.
Coma; sometimes delirium and convulsions.	Weakness and prostration; not unconscious.
Face flushed.	Face pale.
Skin dry and burning.	Skin cool.
Respirations rapid and shallow.	Respirations stertorous.
Pulse rapid and full.	Pulse rapid and feeble.
Temperature 105° to 110° F.	Temperature normal or subnormal.
Suppression of glandular action.	Perspiration increased.
Prognosis guarded.	Prognosis good.

Treatment of Sunstroke.--In all cases of insolation a gag should be inserted between the jaws, to prevent the patient from biting his tongue. In emergencies, a wooden wedge will answer the purpose. The hyperpyrexia must be reduced as rapidly as possible and hydrotherapy will accomplish this better than anything else. Clothing should be removed and the patient placed in a cold water bath at a temperature of about 75° F., with an ice bag applied to the head. Ice should be gradually added to the water until a temperature of 50° F. is reached. Restlessness and convulsions may require morphine. When the patient is returned to bed, he should be enveloped in a cold pack with a hot-water bottle at the feet, and cold (70° F.) saline enemata may be given to prevent subsequent recurrence of fever. Antipyrine and blood-letting will also often prove useful. Should the patient recover, he must be warned as to his inability to withstand high temperatures during the rest of his life.

The treatment of heat exhaustion is essentially that of mild shock. The patient should be placed in bed, surrounded with hot water bottles and covered with warm blankets. Ammonia, strong coffee and hypodermic injections of adrenalin chloride are the most efficient stimulants.

CHILBLAIN.

Chilblain is a condition following exposure to intense cold and is characterized by pruritis, local congestion and a tendency to terminate in gangrene. It is due to a too sudden application of heat following the freezing of the part, occasioning an unduly rapid reaction. "Frost-bite" has been used as a synonymous term but its use should be restricted to designate the initial freezing of the tissues only. The constitutional effects of exposure to intense cold are often pronounced.

Treatment of Chilblain.—The general effects of cold should be combated by overcoming the general debility and improving the circulation, by friction and artificial respiration. The best method of local treatment for chilblain is prophylactic and this consists of avoiding contact with heat, rubbing the chilled parts with snow or cold water and gradually raising the surrounding temperature until the natural color is restored, thereby establishing a slow reaction. The frozen areas may be covered for a time with cloths soaked in cold water. If the surfaces are not abraded, the skin should be painted with equal parts of tincture of iodine and tincture of opium, or an ointment of ichthyol and lanoline applied. If blebs

form, they should be punctured. For broken chilblains, Gardiner recommends the following ointment:

Hydrargyri ammoniati	gr. v
Ichthyolis	♏ x
Amylis,	
Zinci oxidi āā	ʒ ii
Petrolatum	ʒ ss

Misce.

If the tissues become gangrenous, the treatment should be based on general principles. It will occasionally be necessary to amputate a portion of an extremity. Massage and suitable exercises are useful in the after-treatment.

CHAPTER IX.

ULCERS—BED-SORES.

ULCERS.

An ulcer is an excavated loss of continuity upon the body surface, a circumscribed area being denuded of its covering, characterized by evidencing no tendency to heal. The term "ulceration" as applied to the disorganization of tissue and granulating wounds is a misnomer. Strictly speaking, a granulating surface is not an ulcer and, in fact, as soon as a true ulcer commences to heal, it ceases to be an ulcer. Ulcers occur most frequently on the leg and are invariably the result of interference with the circulation, the etiological factors being varicose veins, traumatism or constant pressure. Tubercular and syphilitic ulcers are but ordinary manifestations of the diseases themselves and their cure depends more upon appropriate systemic treatment than upon local measures.

For convenience, a varicose ulcer of the leg will be taken as an example of the usual type of ulcer. Such ulcers are frequently encountered in hospital and dispensary practice and, because they so tax the physician's ingenuity and skill, are generally treated with scant courtesy or entirely neglected. To no other cause can the average physician's indifference to these cases be ascribed. The usual picture pre-

senting is a large sore, of irregular outline, with thick, infiltrated and dusky edges and an indurated base, which is often covered with a thin white layer of tenaceous necrotic tissue. Although a chronic condition, an ulcer may suffer exacerbations of more or less acute inflammation. Should it become purulent, suppuration, sloughing and even cellulitis may follow.

Treatment of Ulcers.—The multiplicity of methods of treatment recommended for the cure of indolent ulcers by various writers is a fair indication that no single one always proves satisfactory and efficient. While certain well defined rules may be formulated, the surgeon must exercise his judgment and common sense in each case to obtain universally gratifying results. Each step in the treatment should be carried out with a definite object in view and advance can be made upon the previous firm foundation only:

1. Improve the local circulation.
2. Cleanse the ulcer and surrounding skin.
3. Subdue inflammation.
4. Remove necrotic tissue from the surface of the ulcer.
5. Promote absorption of the induration.
6. Stimulate granulation.
7. Support the part with equalized pressure.
8. Encourage cicatrization.
9. Have the patient wear a permanent support.
10. Improve the patient's general condition.

To improve the circulation, the patient should be confined to bed or a chair and the leg elevated. Un-

fortunately, however, it is rare that the patient will obey these instructions, as he can illy afford to neglect his occupation.

If all surgeons would use soap and water with the regularity with which they employ antiseptics, the latter could often be dispensed with and healing would occur much more rapidly. The ulcer and surrounding skin should be vigorously scrubbed with a soft brush or gauze wipe. After drying thoroughly, the part should be rubbed with alcohol to loosen scales of dried discharge and devitalized skin.

If inflammation is present, it can be reduced by daily applications of large wet dressings of Thiersch's solution or aluminum acetate, covered with a firm gauze bandage. Asepsis may be secured by painting the ulcer with tincture of iodine at each dressing. The gauze must be kept constantly wet until the inflammation is subdued. If, however, there is no evidence of inflammatory reaction and the ulcer is dirty and foul, it should be cleaned up by dressing with balsam of Peru for a few days. The constant warm bath by immersion in hot saline solution, as described in the treatment of burns, is another excellent method of treatment.

The necrotic layer often observed on the surface of an ulcer is most easily removed by dissecting off with thumb forceps and scissors, followed by delicate curettage.

Absorption of the indurated tissues at the base and margins of the ulcer is best accomplished by criss-cross incisions, carried well through the cicatricial tissues at the base and edges. Alternate hot and

cold douches and massage are useful adjuncts to the incisions.

As soon as the inflammation abates and the ulcer presents a "clean" appearance, the leg should again be cleansed with soap and water and shaved from ankle to knee. The ulcer should be sprinkled with a generous layer of powdered naphthalin crystals to stimulate granulation and then covered with a layer of lint spread with diachylon ointment.

These applications should be left undisturbed for about ten days, meanwhile exerting constant equalized pressure over the whole surface of the part. This is best done by strapping from ankle to knee, from below upward, with zinc oxide adhesive plaster strips, three-fourth of an inch wide and long enough to completely encircle the leg with overlapping of the ends. The edges of each strip should overlap the preceding one (Fig. 20). When complete, the dressing should be covered with a firm bandage or an elastic stocking. To remove the dressing, saturate it with gasoline, cut from below upward, and strip off in one sheet. If the granulation tissue is still some distance from the skin surface, another similar dressing may be applied for the next week. As soon as the granulations approach the surface, however, the ulcer should be irrigated with saline solution and Thiersch's skin-grafts spread upon its surface. Exuberant granulations are easily removed by touching with stick silver nitrate. The grafts must overlap each other and the skin margins and should be covered with several layers of silver leaf. The leg is restrapped for two or three weeks, protecting the area

of the ulcer by smearing the superimposed strips with vaseline. This dressing must be removed very carefully and the ulcer will then be found to be healed.

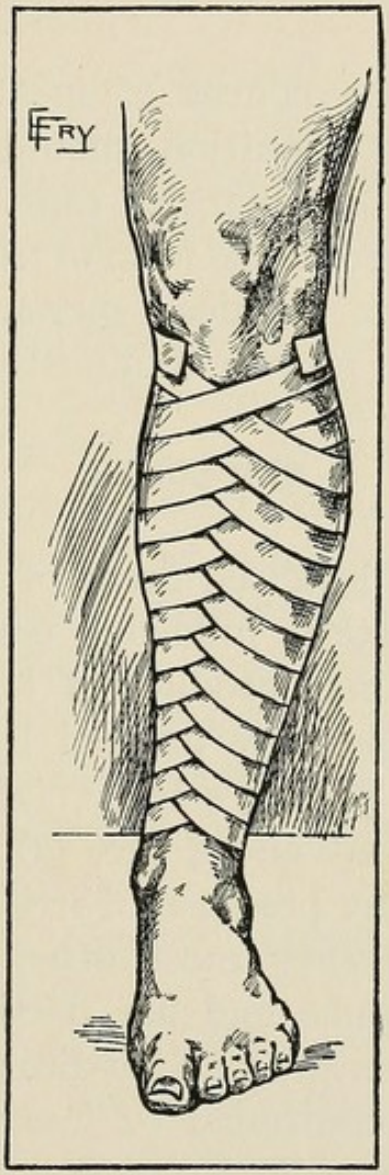


FIG. 20.—Strapping a leg ulcer.

The patient should be instructed to wear a firm elastic stocking continuously, protecting the delicate skin by wearing a white silk or cotton stocking underneath the elastic one. Johnson recommends

sewing four or five ordinary dress stays at varying intervals around the top of the stocking to prevent rolling downward, if the stocking is one that reaches to the hip. When the rubber begins to stretch from constant use, it should be replaced with a new stocking.

Throughout the course of local treatment the patient's general condition should receive careful attention. The emunctories must be kept active and tonics supplied in the form of fresh air and nutritious food. Nux vomica, mercury, arsenic and potassium iodide may be administered with benefit.

BED-SORES.

Bed-sores are localized areas of gangrene due to the circulatory stasis following continued pressure on the skin. Their production is favored by (1) the continuous pressure exerted by the stationary position of the patient's body, (2) arteriosclerosis, (3) debility, (4) advanced age, (5) imperfect innervation and (6) the presence of irritating bodies and secretions. Bed-sores most often occur over the sacrum and scapulæ and are particularly common in spinal affections and wasting diseases. In fracture cases, the long continued or faulty application of splints or plaster-of-Paris dressings may cause pressure sores which are identical with bed-sores.

Competent nursing usually prevents the development of bed-sores and in all instances in which the patient is confined to bed for any length of time the following precautions should be observed:

1. Change the position of the patient frequently, to avoid constant pressure on any one region.

2. Bathe the entire body surface daily and follow with an alcohol sponge. If washing with soap and water is impracticable, the patient can at least be sponged with alcohol.

3. Keep the bed scrupulously clean, frequently brushing the sheets free of crumbs, etc., and keeping them dry and smooth. If the bedding becomes soiled with perspiration, urine or feces, it must be changed immediately.

4. The water-bed and air cushions should be used in suitable cases from the beginning. It is not necessary to wait for areas of congestion to appear. Chamois skin, applied with its softer side to the area of skin affected or threatened, will also be found useful in the prevention of bed-sores.

5. The areas that are unavoidably subjected to pressure and which cannot be comfortably supported with a circular air cushion should be protected by placing cotton-wool or leather-backed adhesive plaster under them.

6. Glycerite of tannin, rubbed in twice daily, will harden the skin.

If the parts exposed to pressure commence to show signs of congestion, they should be sponged with a one in eighty solution of creosote in alcohol, carefully dried and generously dusted with zinc oxide powder. Applications of a 5 per cent. solution of silver nitrate are also serviceable at this stage. When the skin has broken down and the bed-sores have actually formed, they should be covered with a moist gauze

dressing of aluminum acetate. Each day when the dressings are renewed, the visible sloughs should be removed and the surface painted with a 2 per cent. solution of silver nitrate. After the sloughs have separated and healing progresses, the dressings should consist of balsam of Peru or boric acid ointment.

CHAPTER X.

FOREIGN BODIES.

All extraneous material entering or becoming embedded in the tissues must be considered foreign matter. Foreign bodies may consist of practically any substance and in size may vary from infinitesimal particles to large masses. The presence of foreign bodies in the tissues is an item of importance, because of the mischief they may cause. Exceptionally, a patient may be unaware of the entrance and presence of a foreign body, it may become encysted and remain in the tissues for a long period without arousing his suspicion. Contrariwise, foreign bodies may give rise to (1) irritation, (2) pressure, (3) erosion, (4) infection, (5) sloughing, (6) secondary hemorrhage, and (7) interference with healing, usually in the order mentioned. As a rule, the longer they are left undisturbed, the more difficult their subsequent extraction or removal and the more serious the consequences. Moreover, foreign bodies have a tendency to migrate, because muscular contraction and the elasticity of the tissues push them on, until after a lapse of time they will often be found far from the original point of entry. It is therefore obvious that all extraneous material should be removed as early as possible.

Foreign bodies must be accurately located prior to any attempt at removal. Inspection, palpation,

gentle sterile probing and radiography are the most reliable methods for ascertaining their exact situation. It must be remembered that a single *x*-ray view is deceiving, since it affords no information as to the exact depth to which a foreign body has penetrated. The examination should include both an antero-posterior and lateral view. The fluoroscope may be employed to determine whether or not a foreign body moves simultaneously with the soft structures, as, for example, it invariably does when embedded in a tendon.

To remove foreign bodies, the most efficient means, in order of their advantage, are: (1) irrigation, (2) sponging, (3) the use of forceps and curette (preceded by incision, if necessary), and (4) magnetism.

Foreign Bodies in Subcutaneous Tissues.—The majority of foreign bodies enter the subcutaneous tissues through an open wound and their removal is usually a simple procedure, except in punctured wounds. The latter are produced by sharp-pointed objects, the slightest fragments of which, if remaining in the tissues, may cause more difficulty in removal than the appearance of the wound would indicate. The subsequent contraction of the skin aperture or even its union *per primam* may cause the operator much annoyance.

After having precisely located the foreign body, the overlying skin is anesthetized and incised. The incision should be sufficiently extensive to permit thorough search. An incision that is too small is worse than useless, since blind efforts at extraction

only result in pulling up shreds of tissue and may push the foreign body still deeper into the tissues. The best course is to wait until the object becomes visible before attempting its removal. It should then be firmly grasped with forceps and carefully withdrawn. When the object is a long, slender, sharp-pointed body, Quain recommends that an incision be made some little distance from the foreign body, so that it may be grasped with forceps at right angles to its longitudinal axis and then pushed out

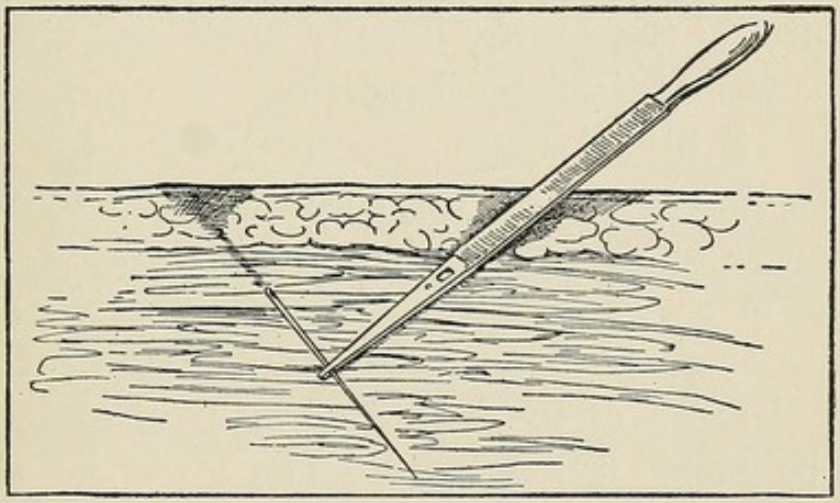


FIG. 21.—Quain's method of removing a deeply embedded foreign body through an incision at the point of entrance, by introducing forceps through a second incision.

through another smaller incision at the point of entrance (Fig. 21). If a foreign body is embedded beneath a nail and does not project sufficiently to permit easy extraction, the nail may be painted with liquor potassæ and the softened surface scraped off, until the remaining nail is as thin as paper. It may then be incised, elevated and the foreign body removed.

Foreign bodies in the eye may vary from a small

particle of dust to a splash of molten metal and usually lodge in the conjunctiva or become embedded in the cornea. They are not infrequently associated with burns, particularly if the offending substance is of a caustic nature. Although immediate removal is imperative in all these cases, when foreign bodies have penetrated to some portion of the eye other than the conjunctiva and cornea, dislodgment should be attempted by those solely who have had special ophthalmological training. Efforts of the inexperienced to remove foreign matter from the deeper structures of the eye are usually futile and the sight may be jeopardized by injudicious treatment. The nervous sensibilities and structure of the eye are so delicate that none but the simplest cases should be be treated by the general surgeon. Two or three minims of a 4 per cent. solution of cocaine hydrochlorate dropped into the eye will facilitate inspection and removal by relieving the pain and spasm and abolishing the reflexes. The lower lid should first be drawn downward and the patient directed to look up. This exposes the conjunctival folds and the surface may be examined by oblique illumination. The surface of the cornea should next be scrutinized through a magnifying lens, allowing the rays of light to play over the surface. Lastly, the upper lid should be everted over a probe, with the patient looking downward, and the tarsal folds carefully inspected. As soon as the foreign body is detected, the surface on which it lies should be brushed with a little cotton on an applicator, dipped in boric acid solution. If this fails to remove it, the foreign body being deeply

embedded, it will be necessary to lift it out gently with a sterile spud. Small bits of metal occasionally become jammed in the conjunctiva or sclera. In these cases the proximity of a powerful electric magnet is usually sufficient to remove them. Sometimes a patient will complain of the presence of a foreign body in the eye when none can be detected. This is due to irritation, which often persists after extraneous material has been spontaneously removed. Having eliminated the foreign material, the eye should be flushed with a warm boric acid solution and soothed with a drop of pure castor oil. When a chemical burn also exists, it should be neutralized, sterile olive or castor oil being afterwards dropped into the eye and cold wet compresses applied.

Foreign bodies in the external auditory canal may consist of animate or inanimate objects. The animate objects should be killed by dropping a little sweet oil in the ear, after which they may be removed by syringing copiously. When syringing, the stream should be directed along the roof of the canal, so that the return flow will be as forcible as possible. Occasionally it will be necessary to hook behind the foreign body with a wire loop, scoop, or a hooked probe, but forceps should never be employed. Foreign bodies of a vegetable nature swell when immersed in water and therefore cannot be removed in the ordinary way. A little alcohol, however, dropped into the ear and permitted to remain for a few minutes will shrink them, after which they may be syringed out with more alcohol. Syringing is the safest method of removing all foreign bodies from the auditory canal and

should be continued until their removal is effected. If instrumentation is absolutely necessary (very rare), the manipulations should be deliberate but exceedingly gentle. Meningitis has resulted from unskilled efforts to remove foreign bodies from the ear.

Foreign bodies in the nose are often difficult to detect, because they may remain in the nose for some time without attracting the patient's attention. A discharge resulting from inflammation or pressure necrosis may be the first manifestation of the presence of a foreign body. This can usually be located with a probe and may be removed by hooking behind it with a scoop or wire loop. Another efficient method of removal is to push the foreign body back to the pharynx. When this is done, the patient's head must hang down, to prevent the dislodged foreign body dropping into the larynx. In struggling children, removal is often attended by dangers from traumatism and by occasional failure. An ingenious procedure in such instances is to hold one hand over the patient's mouth and insert one end of a piece of rubber tubing snugly into the free nostril. The other end of the tubing is held in the mouth of the operator. A sudden, vigorous expiration through the tube will frequently dislodge the foreign body. Sometimes it is necessary to narcotize children before attempting removal.

Foreign Bodies in the Pharynx, Larynx and Trachea.—The entrance of foreign bodies into the air passages is an accident of frequent occurrence and usually produces symptoms of alarming urgency. When located in the pharynx, they are easily removed

by illuminating the region in which they lie and extracting with curved forceps. The ordinary probang is of slight value, as it usually scratches and irritates the mucous membrane without removing the object. Induration and abscesses are not rare sequelæ in these cases, hence the entire surface should be closely searched. Foreign bodies may become impacted in the larynx or inspired through it into the trachea and, unless promptly removed, dyspnea, cyanosis, asphyxia and death speedily ensue. A foreign body may sometimes be felt and displaced by thrusting a finger down the throat. If this is not feasible, an opening should be instantly made into the cricothyroid membrane. Since the immediate admission of air to the lungs is the important factor, rather than the actual removal of the foreign body itself, laryngotomy is recommended instead of tracheotomy, because the urgent symptoms are usually found in the cases where the foreign body is impacted in the glottis, tracheotomy requires more time, and laryngotomy is the safer in inexperienced hands. Should subsequent tracheotomy be necessary for extraction, the laryngotomy offers no impediment to its performance. Artificial respiration is frequently a useful adjunct in relieving the suffocation. Having again induced respiration, efforts should be made to ascertain the position of the obstruction. Careful laryngoscopic examination may reveal the location of the foreign body and it may then be removed with laryngeal forceps. It may often be dislodged by inverting the patient and slapping him on the back. This, however, is a dangerous procedure,

unless laryngotomy or tracheotomy has been performed, as the body may impact in the vocal cords and again suffocate the patient.

Foreign Bodies in the Esophagus.—Large masses of food, coins, buttons, false teeth and pieces of bone may be swallowed accidentally and lodge in the esophagus. If the foreign body has remained for some time, it may cause a variety of symptoms: dysphagia, pain, tenderness, reflex cough, elevation of temperature, hemorrhage or emaciation. On the contrary, it may produce little or no discomfort. The dangers of permitting a foreign body to remain in the esophagus are: (1) pressure necrosis, (2) perforation, (3) peri-esophageal abscess, and (4) starvation. Occasionally a patient will swallow something that will wound the esophagus and he will experience the sensation of a foreign body being present. The history is usually indefinite and of little diagnostic value. The most valuable means of determining the presence or absence of a foreign body is an *x*-ray picture. It can also usually be detected by passing an esophageal bougie. Unless promptly removed, the prognosis may be serious; death may occur form starvation, sepsis or ulceration into the aorta. Foreign bodies generally lodge behind the larynx or near the cardiac orifice of the stomach, these being the points at which the lumen of the esophagus is narrowest.

If situated high up, a foreign body can sometimes be hooked up with the forefinger or removed, through the mouth, with forceps. A large bolus of food, swallowed quickly, may carry it into the stomach.

If it is known that the foreign body is not sharp, the patient may be caused to vomit by tickling the back of the throat and the foreign body may be projected. This, however, is a dangerous procedure if the object is sharp. A useful device is the ordinary horse-hair probang, which is introduced closed, passed beyond the foreign body, opened and withdrawn. When it is necessary to use the "coin-catcher" or long curved forceps, the instrument employed must be manipulated with great care. It is prudent to utilize the fluoroscope when attempting instrumental extraction, as perforation of the esophagus is very easy when ulceration already exists and is an exceedingly dangerous accident. When the foreign body is located near the cardiac orifice, it can occasionally be pushed into the stomach with the blunt end of a stomach tube. The esophagoscope is a valuable instrument for the detection and extraction of a foreign body. When used for this purpose, after cocainizing the pharynx, it should be introduced under the guidance of the operator's eye and without the obturator. As soon as the foreign body becomes visible, it is seized and withdrawn with forceps. The esophagoscope is a dangerous instrument, however, in inexperienced hands, as the slightest inaccuracy may cause injury of the mucous membrane or preforation of an area of ulceration. A cervical peri-esophageal abscess is an absolute contra-indication to the use of the esophagoscope. If all other methods fail, an esophagotomy or gastrotomy must be performed.

CHAPTER XI.

SURGICAL SHOCK AND COLLAPSE—DEATH.

SURGICAL SHOCK AND COLLAPSE.

Surgical shock is a series of events or an assemblage of phenomena caused by injury, characterized by a persistent depression of arterial tension, due to loss of vasotonic or vasomotor activity, thereby giving rise to venous stasis in the large internal veins, with a subsequent nervous exhaustion of the cardiac and respiratory centers and cerebral anemia. In other words, shock is a symptom complex, the essential phenomenon of which is reduced blood pressure. The terms shock, collapse, and syncope are often confused and used interchangeably. In fact, some writers maintain that collapse is merely a mild form of shock. The latter, however, is a simultaneous suspension of function rather than a true exhaustion of all the nerve centers and is caused by actual loss in volume of the blood (hemorrhage); by oxy-hemoglobin starvation. Synocope (fainting), on the other hand, is but a temporary cerebral anemia, induced by a momentary hyperemia, else where, thus disturbing the normal blood pressure equilibrium, which is rapidly and spontaneously restored. It is to such later investigators as Crile, Cushing, Wainwright and others that we are indebted for experimental work on shock in physiological

laboratories and clinical practice and every student should inform himself regarding recent research work in this field, on which studies the logical consideration and rational treatment of shock are based. The subject is one of such magnitude that it is obviously beyond the confines of this volume. In shock, all vital centers suffer primary hypertension but the vasomotor center soon becomes exhausted, lowering the blood pressure, with exhaustion of the cardiac, respiratory and other centers, subsequently causing a cerebral anemia due to loss in circulatory force. In collapse, the centers are not primarily stimulated but directly depressed by the actual loss of blood, and all centers are depressed simultaneously. The longer the hemorrhage continues the longer will the suspension of functions exist. Consequently, the return to normal depends upon the restoration of the volume of blood.

Causes of and Factors Predisposing to Surgical Shock and Collapse:

Shock
- 1. Traumatism
  - Accidental injury.
  - Operations
    - Rough handling of tissues.
    - Susceptibility of certain structures (periosteum, peritoneum, etc.)
    - Exaggerated nervous impulses (from severing large nerves, etc.).
    - Prolonged operating.
- 2. Burns and scalds.
- 3. Psychic disturbances (fear).
- 4. Excessive anesthesia.
- 5. Loss of vital heat.
- 6. Infantile, diseased, feeble and aged subjects.

Collapse { Hemorrhage { Accidental. / Incidental. / Sudden withdrawal of large quantities of fluid (ascites, etc.).

Manifestations of surgical shock and collapse may develop suddenly or appear gradually. The symptoms of shock are: (1) prostration, (2) pallor, (3) pale lips, (4) dull and staring eyes with dilated pupils, (5) clammy, moist skin, (6) cold extremities, (7) frequent, feeble and irregular ("thready" or imperceptible) pulse, (8) marked reduction of blood pressure, (9) feeble respiration, (10) muscular relaxation, (11) subnormal temperature, and (12) occasionally relaxation of the sphincters of the bladder and rectum and (13) nausea and vomiting. The patient's mentality may vary from perfect retention of the senses to absolute insensibility. The evidences of collapse are essentially those of shock with three notable additions: persistent thirst, restlessness and air-hunger. In diagnosis, the history, nature of the injury and a blood examination should all be considered. Oligocythemia (a red cell count of 3,500,000 or less) and diminished hemoglobin suggest collapse from hemorrhage rather than shock. Of course, it is not unusual to observe an association of both shock and collapse in the same subject. Assuming the normal blood pressure to lie between 120 and 140 mm. Hg., a pressure of 100 mm. may be considered indicative of mild shock, at or below 90 mm. medium and at or below 70 mm. profound shock. The concensus of opinion seems to be that if profound shock once becomes firmly established,

it is irremediable. In these cases the mechanical effect of appropriate treatment may raise the blood pressure temporarily but a true reaction is not effected and secondary shock invariably follows. An accurate sphygmomanometer is an indispensable instrument and should be employed in all cases of shock and collapse.

Prevention of Surgical Shock and Collapse.—With a knowledge of the predisposing and exciting causes of these conditions, it is obvious that much can be done in some instances to prevent or limit their development, and to avoid their many vicious sequelæ. Unfortunately, those cases resulting from accidental injury are beyond the surgeon's control, hence prophylactic measures can be applied in operative cases only. These will consist of: (1) preliminary stimulation, (2) allaying the patient's fears, (3) a preliminary hypodermic injection of morphine and atropine, (4) maintaining the body heat, (5) perfect technic, (6) avoiding prolonged exposure and rough handling of sensitive tissues, (7) exact hemostasis, (8) operating expeditiously, and (9) appropriate after-treatment. When a patient exhibits evidence of beginning shock during operation, it is more prudent to stop immediately and defer the completion of the operation until the next day than to proceed and "hope against hope that the patient will not die cured." Certain structures being particularly sensitive to stimulation and traumatism, such as the periosteum during amputation, etc., preliminary nerve blocking with cocaine, as advocated by Crile, is of great benefit. This may be obtained

either by spinal analgesia or by injections directly into the nerve sheaths. The cocaine blocking lessens the blow to the vasotonic centers and distributes the violence over a longer period; large nerves, periosteum, etc., may then be severed with impunity. To avoid collapse when performing a phlebotomy or paracentesis, emptying a distended bladder, etc., the fluid should be withdrawn slowly and the entire amount should never be removed at one sitting. The surgeon is often confronted with the question of operating during shock and this point is still the subject of much controversy. In general, sagacity dictates to wait until reaction has occurred, unless operation is imperative to save life. Under such circumstances, general anesthesia should be avoided as often as possible. If the operation is deferred until reaction occurs, hemorrhage must be controlled and the injured area protected with a wet dressing. All cases of profuse hemorrhage, primary or secondary, internal or superficial, and all those of visceral perforation must be operated upon immediately regardless of shock, else death from exsanguination or sepsis is certain.

Treatment of Surgical Shock and Collapse.—Since these two conditions differ physiologically, their treatment is different. The cardinal principle of the treatment of shock is to establish reaction and stimulate cardiac action, while the main indication in the treatment of collapse due to hemorrhage is to aid in the restoration of the blood to its normal volume.

The reaction from shock consists of permanent

elevation of the depressed blood pressure, evidence of which is a re-appearance of the natural color and warmth of the skin, a pulse more full and forcible, deeper respirations and returning sensibility or a quiet sleep. Some writers describle a condition of excessive reaction, characterized by sudden hyperpyrexia and coma without a corresponding improvement in the pulse and respiration, which they ascribe to a septic intoxication. It is more usual at the present time, however, to observe either a delayed or incomplete reaction or no reaction at all, when the patient does not respond to remedial measure. If the patient is in great pain when first examined, he should receive 1/4 to 1/2 grain of morphine, be put to bed at the earliest possible moment, covered with warm woolen blankets, being careful not to impede respiration, and surrounded with hot water bottles or hot bricks. The latter should be wrapped in cloths to prevent contact with the body surface, because prostrated and unconscious patients are especially prone to burns The foot of the bed should be elevated to lower the patient's head, and to favor a return of blood to the brain. The exceptions to this rule are cases of excessive intracranial pressure. In these cases, even though shock exists, Dawbarn, Mayo and others recommend a partial cerebral anemia, procured by sequestration of a large quantity of blood in the extremities. The latter is easily obtained by cording the limbs at their proximal extremities, exerting sufficient pressure to impede the venous but not the arterial current nor to markedly impair heart action. Mani-

festly, this is the reverse of another valuable adjunct in the treatment of all other cases of shock; bandaging the extremities from the distal end toward the trunk, to fortify the vital centers with an extra supply of blood. Crile has elaborated this principle in his rubber pneumatic pressure suit. It will not be amiss to repeat that while these measures conduce to safety in the ordinary cases of shock, they add to the danger in cases of intracranial pressure. Hot normal saline solution should be used early, as it has a most excellent effect upon unstriped muscle and cerebral sympathetic centers. It may be administered by hypodermoclysis, enteroclysis or intravenous infusion. Both Dawbarn and Kemp have shown conclusively that the customary temperature of 104° F. is too low and that the best and most permanent results upon the heart and blood-vessels are obtained when the saline solution is given at 116° to 120° F. About two quarts should be cautiously introduced; at least twenty minutes are required for its administration, to avoid overwhelming the heart. Hypodermoclysis or enteroclysis are preferable to an intravenous infusion, because the flow can be accelerated or retarded more conveniently. Adrenalin chloride (1–1000) acts by toning up the unstriped muscle of the blood-vessels and 15 or 20 minims may be added to the saline solution. Frequent sphygmomanometric readings should be taken during the introduction of the solution and when the pressure rises to 120 mm. it must be discontinued. Twitching of the limbs heralds the development of convulsions and is another indication for stopping the ad-

ministration of the saline. Should the pressure again fall perceptibly and the pulse become weaker, the adminstration may be resumed. For this purpose, Kemp's rectal tube is of service. A permanent blood pressure of 100 mm. and a pulse rate of 120 may be considered the limit of safety. Morphine, ammonia, adrenalin and ergot (ergotole) are the most valuable drugs in shock. In emergencies, ammonia acts as a harmless stimulant and oft-times contributes to the prevention or modification of shock. Morphine, in quarter-grain doses, is useful to allay pain and quiet the patient and as a mild circulatory stimulant. The latter virtue is one often overlooked by many physicians. Ergotole and adrenalin chloride (1–1000) may be administered in saline infusion or hypodermatically or the adrenalin may be slowly dropped into the nostrils. The administration of these preparations must be frequently repeated, as their effect is more or less evanescent. The time-honored "stimulants," such as strychnine, alcohol, nitroglycerine, etc., have been proven to be physiologic fallacies and worse than useless. They cannot stimulate the already exhausted nerve centers, which are incapable of transmitting normal physiological reflexes and responding to stimulation, nor have they any effect on unstriped muscle. They not only fail to mitigate shock but even exaggerate it and have been entirely abandoned by modern surgeons. If respiration flags, artificial respiration may be instituted. The stomach should have complete rest, all food and nauseous medication being withheld during shock and until all danger is past. Strength may be

sustained by nutrient enemata. Hot black coffee, when tolerated, is both a food and stimulant.

The main indication in the treatment of collapse due to hemorrhage is to arrest bleeding, for the longer it continues the more prolonged will be the suspension of functions. When hemorrhage has been controlled, restoration of the volume of blood lost, as rapidly as possible, is imperative. Many of the accessory measures mentioned in the treatment of shock will also prove useful in collapse, but an intravenous infusion alone is practically sufficient to raise the blood pressure and sustain the functions of the centers. In other words, whereas hot saline solution is a valuable auxiliary in cases of shock, it is an absolute necessity in those of collapse; without it medication is useless. Under these circumstances, it is desirable to introduce the saline solution more rapidly than in shock, hence an intravenous infusion is the method of choice. It may be thrown into any large vein and, although one of the superficial veins of the forearm is usually selected for convenience, the internal saphenous vein anywhere above the ankle, as suggested by Dawbarn, is preferable, because there are no adjacent important structures and a scar on the leg is of no consequence. The patient should be confined to a bed with its foot elevated, external heat applied and the extremities partially exsanguinated, as in shock. To these may be added an increased supply of oxygen, which may be provided by opening windows or inhalations of pure oxygen gas. Direct blood transfusion may be employed when a donor, the necessary facilities and in-

struments are at hand. The drugs used in the treatment of shock are also serviceable in collapse.

Collapse occasionally follows sudden withdrawal of large quantities of fluid; aspirating ascites, or emptying a distended bladder. This accident will never occur, if technic is perfect and the fluid is removed gradually. A large quantity of fluid must be removed slowly and the entire amount never withdrawn at one time.

DEATH.

Many phases of death are more properly included in works on legal medicine and medical jurisprudence and therefore the care of the moribund patient, the determination of death and the physician's subsequent procedure only will be considered.

Because a patient is apparently dying is no reason that he should be neglected. It is well to bear in mind that "while there is life there is hope" and an apparently moribund individual has been known to recover. He should be made comfortable and his waning vitality conserved. Cool, smooth bedclothes that do not restrict or interfere with respiration will materially add to his comfort. If external heat is employed, be cautious lest the sufferer be burned. Catheterization and warm rectal irrigations, as often as required, will prevent excessive intra-abdominal pressure and resorption of noxious material. Oxygen should be liberally supplied to the vitiated atmosphere by opening windows and permitting the entrance of plenty of fresh air or by inhalations of oxygen. Lamps, gas flames and open fires should be avoided, if practicable. Such medi-

cation may be administered as circumstances may demand. Opiates may be freely used if the patient is restless or in physical pain. The attitude of the physician should be one of cheerfulness and encouragement and not indifference.

When circulation, respiration and innervation all cease, the patient is dead. Cardiac action and respiration are not necessarily arrested simultaneously, momentary absence of respiration is not incompatible with the continuance of life, and instances are recorded in which one or the other has apparently ceased and yet the patient recovered. This, however, is open to question. It is more logical to assume that either the heart's action was so extremely feeble or the respiratory movements so shallow that one or the other was imperceptible, even with the stethoscope. Death is usually verified by the cessation of circulation and respiration, corroborated by a stethoscopic examination. In view of the possibility of error in mistaking suspended animation, lethargy, catalepsy, etc., for actual death, the above examination cannot be accepted as adequate. The unmistakable signs of death, upon which a positive determination may be based are: (1) complete arrest of cardiac action, (2) complete arrest of respiration, (3) primary period of muscular relaxation, preceding rigor mortis, (4) abolition of reflexes, (5) intense pallor or discoloration of the skin and mucous membranes, (6) eyes partly open and fixed, (7) flaccidity and softening of the eye-ball, (8) absence of pupillary reaction, (9) gradual opacity of the cornea, and (10) rapid reduction of body temperature.

Death having ensued, it is the physician's duty to thoroughly examine the body and confirm the occurrence by unquestionable evidence. The law regarding the physician's subsequent procedure, in deaths due to other than natural causes, varies in the different States and Counties, but, in general, a death certificate should not be furnished without the authority of the proper official. When the ambulance surgeon is called upon to verify a sudden death, he should note carefully the circumstances and facts but should leave the body undisturbed. This will avoid confusion and obscurity of certain details upon later investigation by the municipal authorities. If, however, the physician is empowered and directed to sign the death certificate in doubtful cases, he should clearly state the means or instrument of death, as well as the immediate cause. The certificate should also state whether the death was due to accident, suicide or homicide.

CHAPTER XII.

MINOR OPERATIONS

ARTIFICIAL RESPIRATION.

Indications.—Asphyxia and suspended animation: (1) inhalation of noxious gases, (2) drug toxemias, (3) submersion, (4) strangulation and (5) electric shocks.

Contraindications.—The patient being in an atmosphere of vitiated air or that contaminated with noxious gases.

Sylvester's Method.—1. Place the patient in a supine position, with the head well extended by a folded blanket under the shoulders (Fig. 22).

2. Stand at the patient's head and grasp the forearms near the elbows.

3. For inspiration, draw the arms steadily and gently well above the head.

4. Keep the arms stretched upward for two seconds.

5. For expiration, turn down the arms, place them by the sides and gently compress the thorax for two seconds.

6. Repeat these movements about fifteen times to the minute.

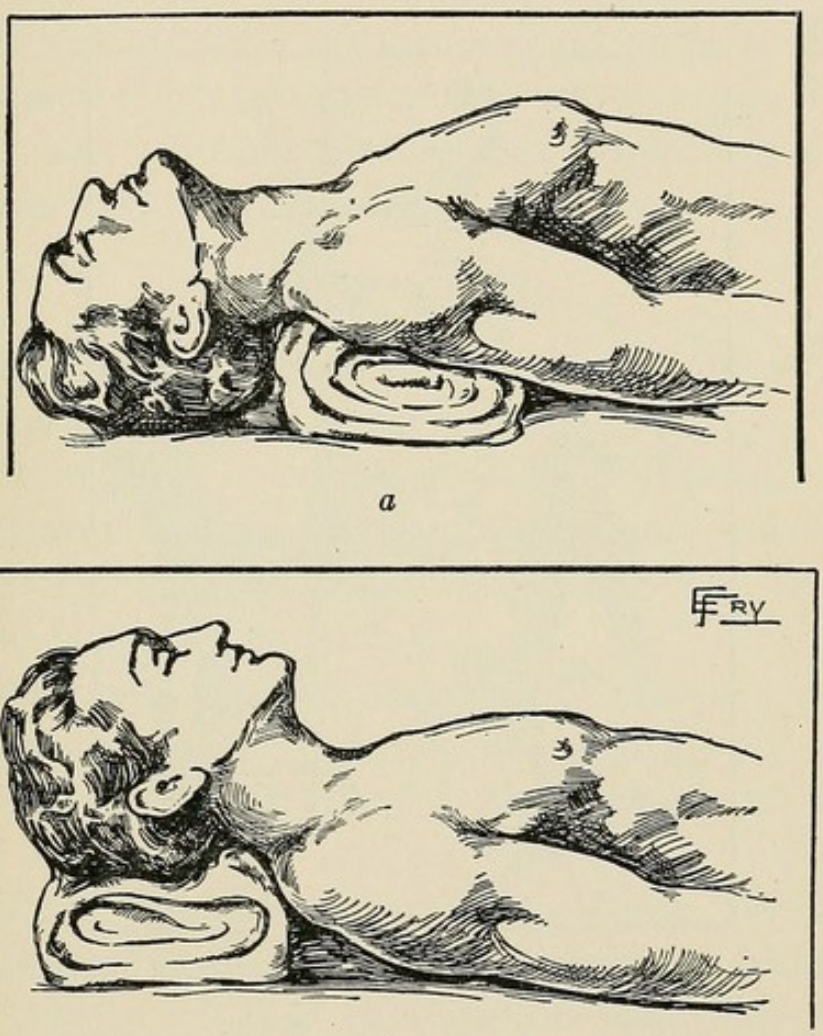
Schafer's Method.—1. Have the patient lie prone, with the face turned to one side.

2. Exert uniform pressure on the lower ribs and loins.

3. Remove the pressure to allow inspiration.

4. Repeat these procedures fifteen times a minute.

Laborde's Method.—1. Grasp the tongue deeply and firmly with a layer of gauze or a flat bladed tongue forceps.



a

b

FIG. 22.—*a*, Correct and *b* incorrect positions of patient for artificial respiration.

2. Draw the tongue forward forcibly and suddenly.

3. Relax the tongue quickly and completely.

4. Repeat this intermittent traction every four seconds.

Faradization.—1. Press one electrode on the right side of the neck over the right phrenic nerve.

2. Apply the other electrode over the lower ribs on the right side (Fig. 23). The left side is avoided in order not to interfere with cardiac action.

3. A weak faradic current is turned on during in-

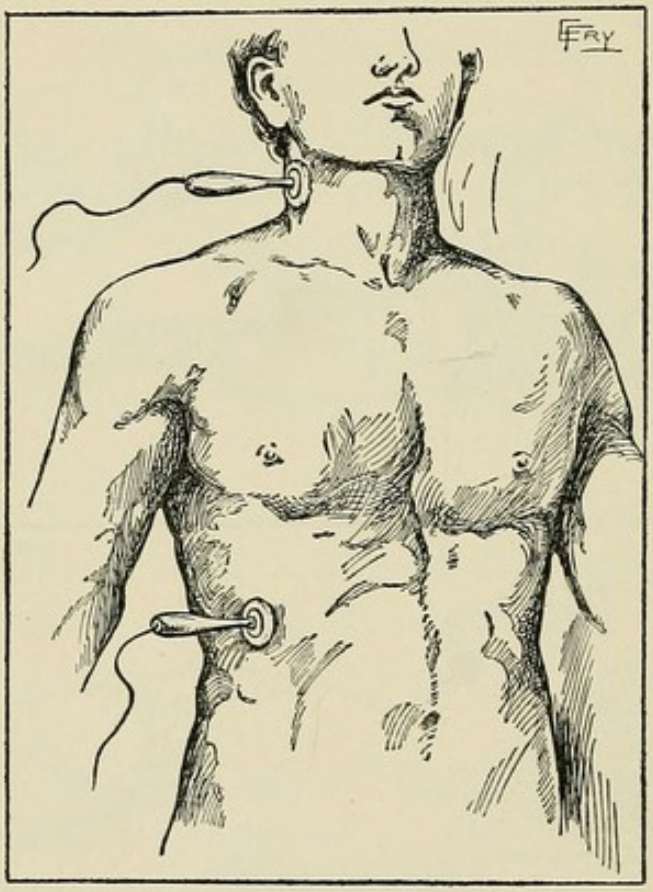


FIG. 23.—Electrodes applied properly to induce inspiration.

spiration and turned off as soon as expiration commences.

Precautions.—(1) Correct diagnosis is important; (2) the upper respiratory tract must be freed from obstruction; (3) if the air is contaminated, pure air must be obtained; (4) impediments to free respiratory movements must be removed; (5) external heat

and friction should be applied early; (6) all manipulations must be deliberately and regularly performed, (7) artificial respiration, when indicated, should always be continued for at least half an hour and persevered in much longer, if there is the slightest indication of life; (8) a combination of the various methods of artificial respiration will often prove advantageous; (9) inhalations of oxygen gas, bloodletting and suitable cardiac and respiratory stimulants are useful adjuncts.

LARYNGOTOMY.

Indications.—(1) Sudden obstruction of the larynx; (2) therapeutic purposes; (3) as a preliminary preventive measure to some surgical operations.

Contraindications.—(1) Obstructions below the larynx; (2) age under thirteen years, as the cricothyroid space is too narrow.

Technic.—1. Extend the patient's neck strongly.

2. Procure local or general anesthesia.

3. Steady the larynx with the thumb and fingers of the left hand.

4. Make an incision from the center of the thyroid cartilage, extending downward an inch and a half.

5. Avoid or ligate and divide the cricothyroid artery.

6. Plunge a knife transversely through the cricothyroid membrane exactly in the median line, to the depth of half an inch (Fig. 24).

7. Causes the opening to gape by everting the lips, until a tube can be procured.

8. Execute the necessary intralaryngeal procedures.

9. Insert a laryngeal tube with the end directed downward.

10. If an obstruction is promptly and permanently removed, the cannula may be omitted and the wound closed with fine sutures.

11. Apply a small square of lint smeared with an

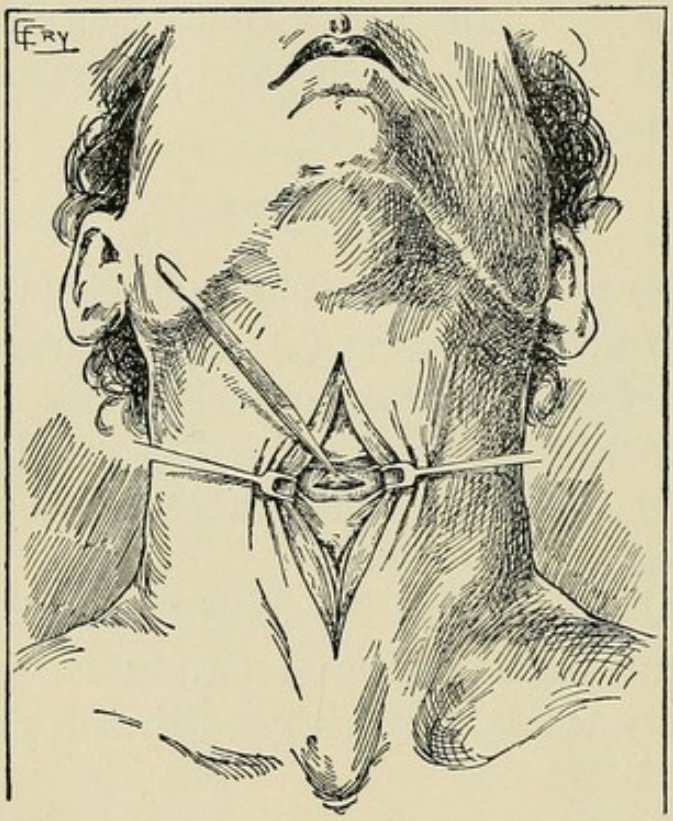


FIG. 24.—Laryngotomy through the cricothyroid membrane.

emollient to prevent irritation of the wound.

Precautions.—(1) Fix the larynx firmly to prevent slipping from under the point of the knife; (2) hold the knife so that not more than half an inch projects beyond the fingers and thumbs; otherwise the larynx may be accidentally transfixed; (3) don't mistake the hyoid bone for the cricoid cartilage.

TRACHEOTOMY.

Indications.—(1) Sudden obstruction of the trachea; (2) therapeutic purposes; (3) as a preliminary preventive measure to certain surgical operations; (4) whether the trachea is opened above (high operation) or below (low operation) the isthmus of the

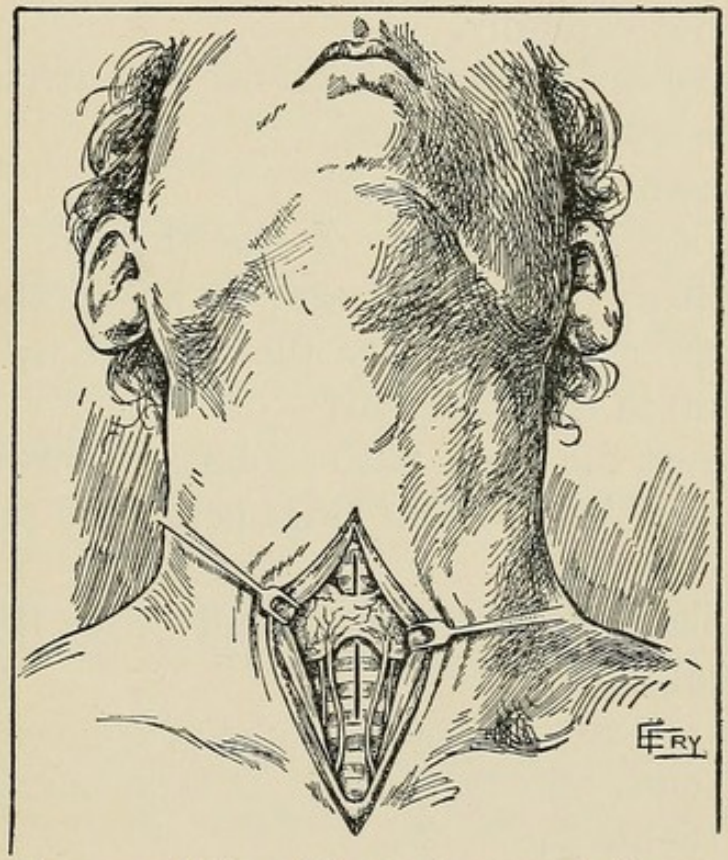


FIG. 25.—High and low tracheotomy incisions.

thyroid body will depend upon the anatomical peculiarities and the existing circumstances in each case (Fig. 25).

Contraindications.—(1) Extreme urgency (laryngotomy preferable); (2) high operation is contraindicated in laryngeal diseases, because the prox-

imity of the tracheotomy cannula may irritate and exaggerate the trouble.

Technic.—1. Extend the neck strongly.

2. Anesthetize the local parts.

3. Make a free incision in the skin according to the location of the proposed tracheal incision, exactly in the median line.

4. Dissect by blunt dissection down to the trachea rapidly but carefully.

5. Have an assistant hold the soft structures to each side with blunt hooks.

6. Control hemorrhage.

7. Avoid the isthmus of the thyroid gland by pushing it up or down, as may be practicable.

8. Draw up and steady the trachea by fixing a tenaculum in its upper part.

9. Thrust the knife, with its back downward, into the trachea three or four rings below the tenaculum and cut upward.

10. Dilate the aperture laterally with the handle of the scalpel.

11. Insert a tracheotomy tube of appropriate size.

12. Secure the tube with a tape carried twice around the neck.

13. Keep the tube clear at all times and prevent access of cold dry air by keeping flannel, wrung out in hot water, over the opening of the tube.

Precautions.—(1) Don't let an over-zealous assistant draw the head so far back as to suffocate the patient before operation is begun; (2) see that all necessary instruments are at hand; (3) make all incisions exactly in the median line and sufficiently

long to secure good exposure; (4) don't open the trachea until all arterial hemorrhage has been controlled; (5) be careful not to transfix the trachea or wound the esophagus when incising the trachea; (6) tracheotomy is a difficult and dangerous operation in inexperienced hands.

HYPODERMIC INJECTIONS.

Indications.—To secure rapid, thorough and certain absorption of medicaments, especially stimulants, sedatives and emetics.

Contraindications.—(1) Irritant substances; (2) insoluble substances; (3) substances ineffective in small dose; (4) when it is necessary for the patient or some other inexperienced person to administer the medication.

Technic.—1. With the needle detached, draw in a syringe full of water.

2. Empty the syringe into a teaspoon or similar article and boil the water over a gas flame or burning match.

3. Dissolve the tablet in the boiled water.

4. Aspirate the resulting solution into the syringe.

5. Screw the needle on firmly.

6. Point the needle directly upward and expel a few drops by gentle pressure on the piston to make sure that the needle and syringe are free from air.

7. Clean a small area of skin with cotton moistened with alcohol.

8. Dry with cotton.

9. Pinch up the skin with the fingers and thumb of

the left hand so that the fold is parallel to the course of the neighboring blood-vessels.

10. Plunge the needle quickly into the subcutaneous areolar tissue, with the point directed toward the body, being careful to avoid blood-vessels

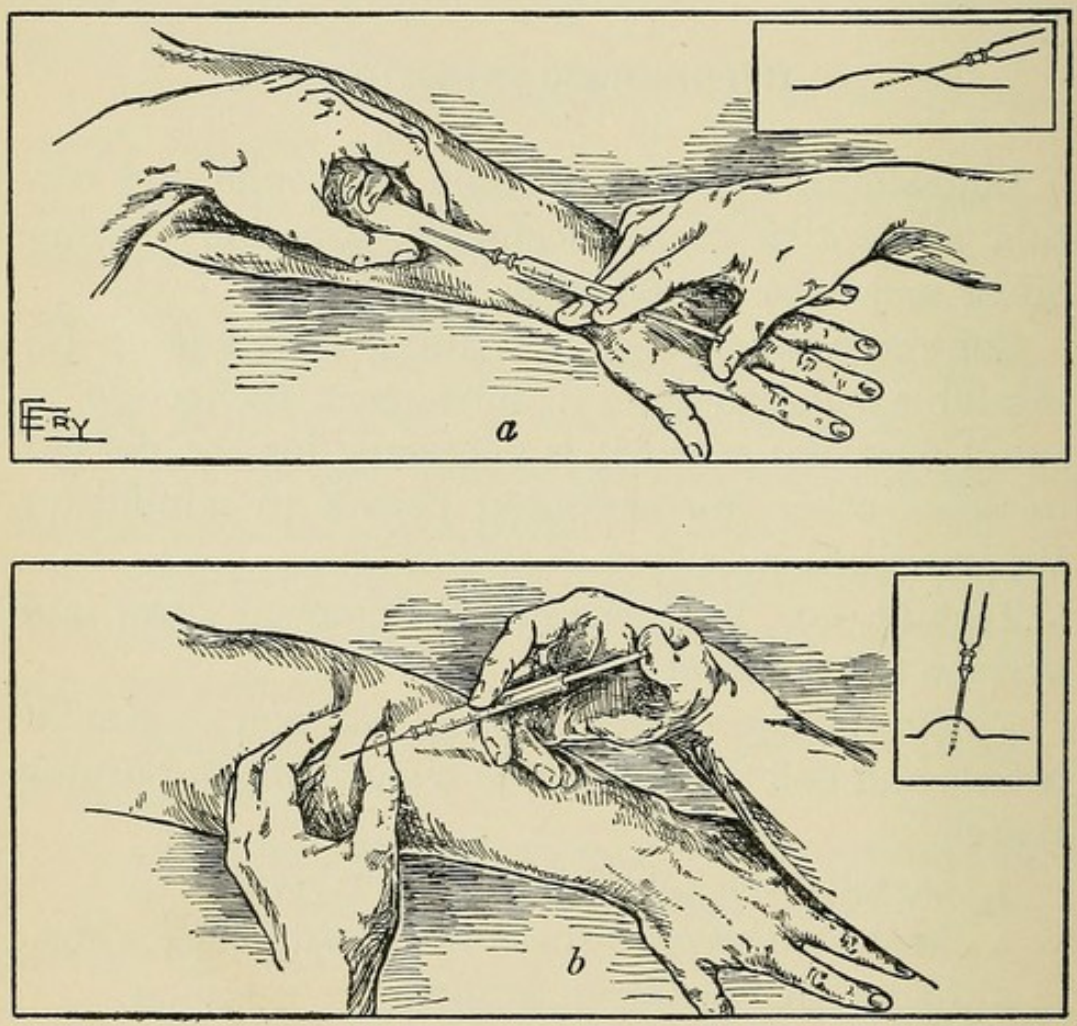


FIG. 26.—*a*, Hypodermic needle introduced correctly; *b*, hypodermic needle introduced incorrectly.

(Fig. 26).

11. Inject the contents of the syringe slowly by exerting uniform pressure on the piston.

12. Withdraw the needle slowly and massage the small tumefaction gently toward the trunk.

13. Seal the point of entrance with collodion.

Precautions.—(1) Select a syringe of uniform caliber with a properly fitting piston; (2) see that the washers are in good condition and that the joints do not leak; (3) the needle must be sharp and pervious; (4) keep a fine wire in the needle when not in use; (5) the solution injected must be perfect, sterile and warm, therefore solutions must always be freshly prepared; (6) strong acid and alkaline solutions are unfitted for hypodermic administration, because they cause severe local irritation; (7) be sure of an accurate dose and avoid hypermedication; (8) don't boil the solution after dissolving the medicament, as many substances are decomposed by a temperature of 212° F.

Dangers.—From faulty technic are: (1) needle abscess, from a non-sterile needle; (2) injecting the medicament into a vein; (3) introduction of air into a vein; (4) subsequent formation of drug habits by the patient (insignificant in emergency cases).

SKIN-INFILTRATION ANESTHESIA.

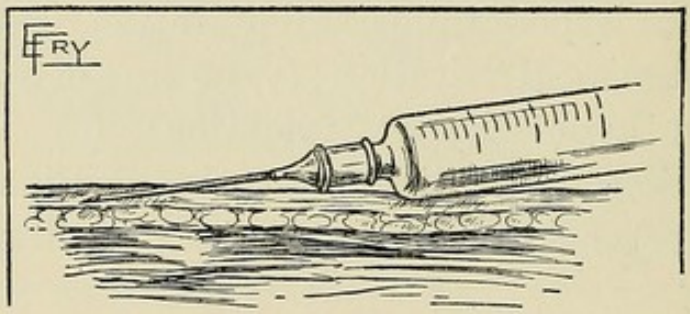
Indications.—To secure local anesthesia, or local analgesia: (1) to minimize or prevent pain in trivial operations; (2) to avoid or limit the necessity for the employment of general anesthesia in major operations.

Contraindications.—(1) Inflammation or its products existing in the tissues subjacent to the region to be anesthetized, because the additional stretching incident to the infiltration of the already tense skin is extremely painful; (2) very young and nervous

patients; (3) regions in which the resulting edema obliterates the dividing line between diseased and healthy tissue.

Technic.—1. Observe all aseptic and antiseptic precautions, as in hypodermic injections.

2. Fill a hypodermic syringe with a 1 per cent. solution of β eucaine or cocaine hydrochlorate, adding a minim or two of adrenalin chloride.



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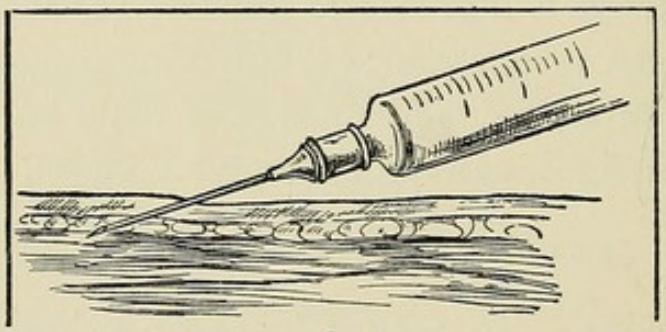

b

FIG. 27.—*a*, Correct and *b* incorrect method of inserting needle for skin infiltration anesthesia.

3. Cleanse the skin with alcohol.

4. Insert the needle into the meshes of the skin itself and not into the subcutaneous areolar tissue (Fig. 27).

5. Inject the solution parallel to the surface, until a good sized wheal is formed.

6. If the first wheal does not cover a sufficient area,

the needle should be re-inserted in its margin and an adjoining one injected.

7. After waiting a few seconds, the skin may be freely incised.

Precautions.—(1) Solutions of cocaine stronger than 2 per cent. are unnecessary and dangerous; (2) the addition of adrenalin chloride has a salutory effect upon the action of the anesthetic (tends to favor hemostasis and prevent a cocaine toxemia); (3) boiling decomposes cocaine solutions; (4) more than one-third of a grain in all should never be used; (5) the duration of the analgesia is increased with an increase in strength of the solution; (6) whenever possible, partial anemia of the part should be procured, as this favors diffusion of the zone anesthetized; when using cocaine anesthesia on a limb, moderate constriction above the point of injection, by retarding venous return, confines the anesthetic locally diminishes general absorption and possible toxemia; (7) a very fine and sharp needle will not cause pain when inserted.

ETHYL CHLORIDE ANESTHESIA.

Indications.—To secure anesthesia of a restricted area, particularly adapted to inflammatory tissue.

Contraindications.—Cases in which deep penetration and dissection of tissue are required, or in which prolonged local anesthesia is necessary.

Technic.—1. Cleanse the skin with soap and water and alcohol.

2. Grasp the container with the whole hand.

3. Loosen the valve sufficiently to permit a fine spray being projected.

4. Direct the spray upon the skin, holding the container some 3 or 4 inches away (Fig. 28).

5. Stop the spray as soon as the skin area is thoroughly whitened.

6. Wait until the whitening has nearly disappeared before incising.

Precautions.—(1) Be sure that the nozzle of the

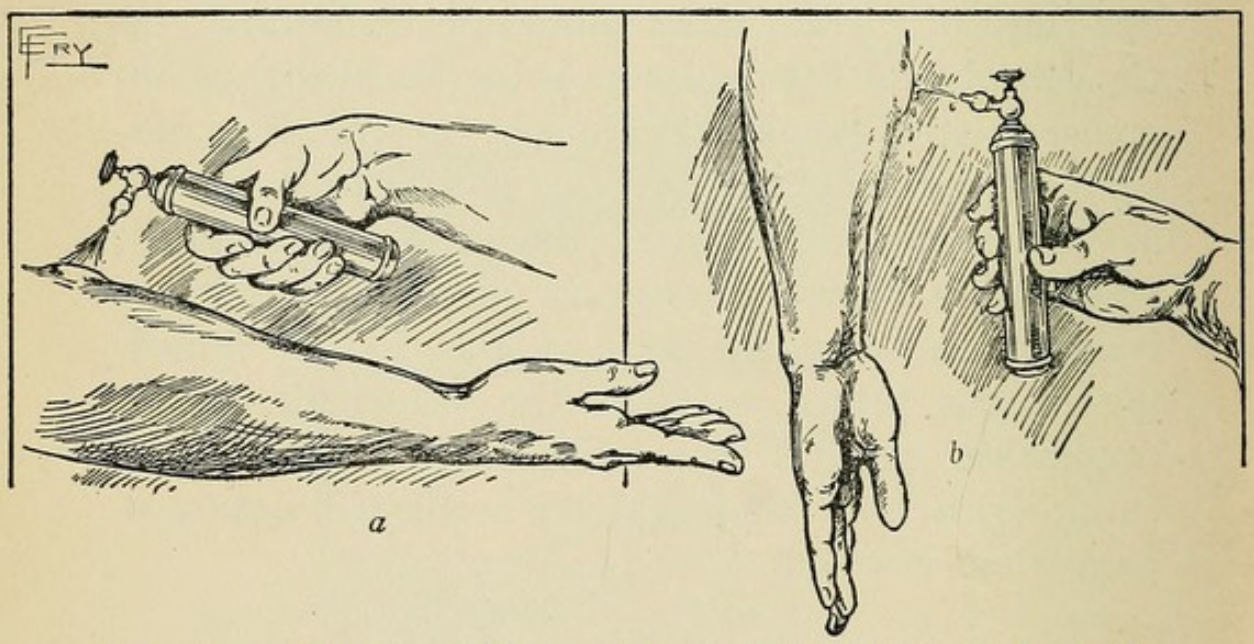

FIG. 28.—*a*, Correct and *b* incorrect method of obtaining ethyl chloride anesthesia.

container does not leak; (2) keep a firm grasp on the container, because it is the heat from the hand that exerts pressure within the tube and causes vaporization; (3) maintain a fine spray but avoid a stream; (4) too prolonged freezing will be followed by devitalization and sloughing; (5) the slight discomfort due to reaction, experienced by the patient afterwards, is of no consequence.

ASPIRATION.

"Aspiration" refers to a method of withdrawing fluids from a cavity by suction, in contradistinction to "paracentesis," which refers to simple puncture of the walls of a cavity. For aspiration an exhausting syringe or apparatus (aspirator) is required, whereas for paracentesis internal pressure and gravitation only are depended upon for removal of the fluid through a trocar or an incision.

Indications.—(1) Diagnostic confirmation; (2) evacuation of collections of serum, blood or pus from a cavity; (3) as an emergency operation in severe cases of retention of urine in which efforts at catheterization have failed; (4) spina bifida.

Contraindications.—(1) Extensive pyemic abscesses; (2) when the density of pus is so great that it will not flow through the needle; (3) when sloughing is extensive and the shreds continually plug the needle; (4) when large blood-vessels or other important structures that cannot be avoided are interposed between the surface and the collection of fluid.

Technic.—1. Observe all aseptic and antiseptic precautions and cleanse the overlying skin or mucous membrane.

2. Press down a small area of skin slightly above the site of the proposed perforation, so that when released by withdrawal of the needle the aperture in the skin will lie above that through the underlying structures, thus avoiding subsequent leakage.

3. Anesthetize the skin with ethyl chloride.

4. Insert a suitable needle, firmly but gradually, until the point is felt to be free in the cavity.

5. Attach a syringe with the piston depressed or the tube of an aspirating apparatus (preferably Potain's aspirator) in the receiving bottle of which a vacuum has been previously created by means of an attached pump.

6. If a syringe is employed, withdraw the piston slowly.

7. If a Potain apparatus is used, open the vent leading into the receiving bottle.

8. If the lumen of the needle becomes obstructed during the out-flow of fluid, it may be cleared by changing its direction, by reversing the action of the syringe temporarily or by removing it, clearing it and introducing it elsewhere.

9. When the flow ceases, the exhausting pump may be operated or the needle slightly withdrawn.

10. When the greater part of the fluid is evacuated, the needle should be removed and the perforation sealed with a little cotton painted with collodion.

11. Exert firm pressure on the part with a suitable dressing to support the walls of the cavity and aid in preventing a return of the affection.

Precautions.—(1) Always test the aspirator before using; (2) be sure that the receiving bottle contains a vacuum and not compressed air; (3) the diameter of the needle selected will depend upon the quantity and viscosity of the fluid to be evacuated through it; it should be reasonably small; (4) the site at which the needle is introduced should obviously be at the lowest accessible point to which the fluid extends;

(5) introduce the needle slowly, so that it will not pass entirely through the cavity and reach the opposite wall or wound deeper structures unnecessarily before the fluid has an opportunity to escape; (6) never remove the whole of a large collection of fluid at one time; (7) re-accumulations are common after aspiration and repetition is often necessary.

PARACENTESIS ABDOMINIS.

Indications.—To evacuate fluid from the abdominal cavity.

Contraindications.—A distended bladder.

Technic.—1. Shave and cleanse the skin.

2. Have the patient sit in a chair or lie on his side on the edge of the bed.

3. Support the abdominal wall by placing a wide bandage or towel with a central opening around the patient and have an assistant exert firm pressure from behind.

4. Draw down the skin immediately above the point to be punctured.

5. Cocainize the area of puncture.

6. Make a small preliminary skin incision in the linea alba.

7. Insert a small straight cannula and trocar, carefully but quickly (Fig. 29).

8. Withdraw the trocar, leaving the cannula *in situ* and have an assistant tighten the abdominal supporter as the fluid is evacuated and the enlargement decreases.

9. If the cannula becomes obstructed, it may be cleared by passing a probe through it.

10. If the fluid flows too freely, it may be retarded by a compress over the outer opening.

11. Withdraw the cannula and seal the opening with cotton and collodion.

Precautions.—(1) Empty the bladder and bowels; mistaking a distended bladder for other collections of fluid is an inexcusable error; (2) verify the area of dulness by percussion immediately before paracentesis; (3) sudden or complete removal of the fluid may precipitate collapse; (4) in general, the precautions for aspiration obtain for paracentesis.

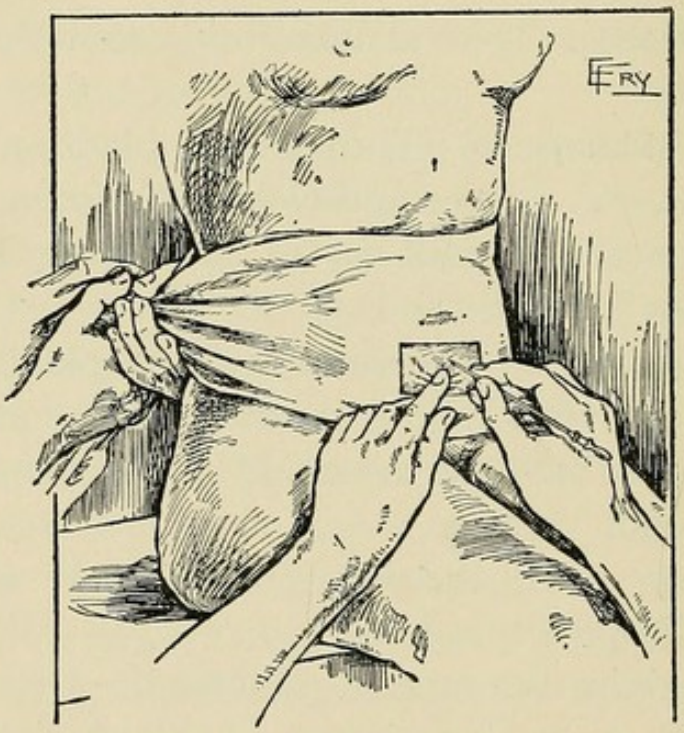

FIG. 29.—Correct position for paracentesis abdominis.

LUMBAR PUNCTURE.

Indications.—(1) To withdraw cerebro-spinal fluid to make or verify a diagnosis or relieve excessive pressure within the vertebral canal; (2) to introduce

antitetanic serum or other therapeutic agents into the cerebro-spinal axis.

Technic.—1. Administer a preliminary dose of morphine and atropine, unless distinctly contra-indicated by the patient's general condition.

2. Have the patient lie on his side on the edge of the bed, with the body curved forward, or have him sit up in the same position.

3. Identify the twelfth dorsal vertebra by means of the last rib and count downward to the spine of the fourth lumbar vertebra. Deep palpation is necessary.

4. Select a point half an inch to the side of the median line and freeze it with ethyl chloride.

5. Incise the skin at this point.

6. Select a slender needle 4 inches long, the stylet of which is ground flush with the end of the needle itself (Dawbarn's needle).

7. Pass the needle through the subcutaneous tissues obliquely upward and inward with the stylet in place.

8. A sense of diminished resistance indicates penetration of the canal.

9. Withdraw the stylet; the issuance of a few drops of cerebro-spinal fluid will follow.

10. Catch the fluid in a test-tube or other suitable container.

11. Withdraw the needle slowly and seal the small skin incision with cotton and collodion.

Precautions.—(1) Strict asepsis is imperative; (2) don't withdraw more than 30 c.c. of fluid at most; (3) don't permit the pressure within the canal to

fall below normal; (4) aspiration is not required and may be dangerous; (5) avoid lateral movements of the needle while obtaining fluid; (6) withdraw the needle slowly.

SPINAL ANALGESIA.

Indications.—(1) Cases in which local anesthesia cannot be utilized; (2) when general anesthesia is distinctly contraindicated; (3) as an auxiliary measure in major operations on the abdomen or lower extremities to prevent shock; (4) to lessen the pains of parturition.

Technic.—1. Puncture the vertebral canal as described under lumbar puncture.

2. Select and sterilize an appropriate dose of one of the following: cocaine, tropacocaine, novocaine, stovaine, eucaine, scopolamine or magnesium sulphate.

3. Draw into the syringe, containing the drug in powder, a sufficient amount of cerebro-spinal fluid.

4. Re-inject as soon as the powder is dissolved.

5. Operation may be commenced within fifteen minutes.

6. To increase the upper limit of analgesia, elevate the foot of the bed.

Precautions.—(1) Boiling decomposes cocaine and its derivatives and they are best sterilized by dissolving in sulphuric ether with subsequent evaporation of the latter, as advocated by Bainbridge; (2) be sure that the drug employed is absolutely sterile, of pure quality and definite strength; (3) be sure

that the needle is not slightly withdrawn while attaching the syringe.

PHLEBOTOMY (VENESECTION).

Indications.—To lower vascular tension: (1) pul-

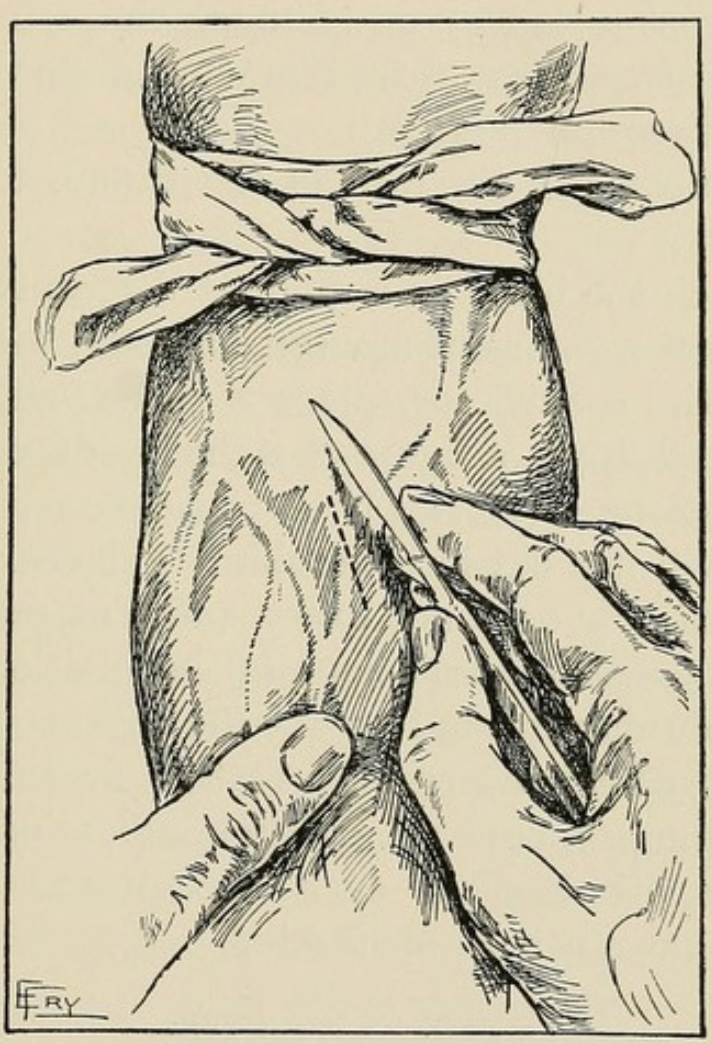

FIG. 30.—Phlebotomy.

monary engorgement; (2) engorgement of the right heart; (3) profound toxemias with full pulse; (4) cerebral apoplexy.

Contraindications.—All conditions accompanied by cardio-vascular depression.

Technic.—1. Shave and cleanse the bend of the elbow.

2. Apply a constrictor a few inches above the elbow.

3. Steady the most prominent vein just below the elbow with the thumb of the left hand.

4. Thrust a lancet or bistoury through the skin and about two-thirds of the diameter of the vein in an oblique direction (Fig. 30).

5. Remove the pressure of the thumb to permit flowing.

6. Catch the blood in a graduated receptacle.

7. When a sufficient amount has been withdrawn, remove the constrictor, place a gauze pad over the wound and apply a figure-of-eight bandage.

Precautions.—(1) Apply a broad constrictor, so that it will not cut into the skin; (2) be careful that the constrictor does not exert sufficient pressure to obstruct arterial circulation; (3) an incision carried too deeply may wound one of the cutaneous nerves or the brachial artery; (4) vertigo or evidence of approaching syncope are positive indications for the stoppage of bleeding, even though the intended amount has not been abstracted.

HYPODERMOCLYSIS.

Indications.—To supply the body with fluid and aid renal and skin elimination: (1) as a prophylactic measure to prevent and as a therapeutic agent in the treatment of shock; (2) uremia not associated with edema; (3) toxemias; (4) when administration of fluids through the stomach is contraindicated.

Contraindications.—(1) Extremely urgent cases; (2) edema of the lungs due to cardiac or renal disease; (3) high arterial tension.

Technic.—1. Select and cleanse an area of skin just above the groin, on the inner side of the thigh or in the submammary region.

2. Fill an ordinary glass irrigating apparatus, with rubber tubing attached, with sterile normal saline solution (2 drams of sodium chloride to a quart of water) at a temperature of 116° F.

3. Attach an aspirating needle to the free end of the rubber tube.

4. Elevate the needle and open the stop-cock, thus freeing the tube and needle of air.

5. Introduce the needle at the selected site into the subcutaneous areolar tissue.

6. Elevate the reservoir about 2 feet above the level of the needle.

7. After all the solution has been injected, massage the tumor lightly, from below upward.

Precautions.—(1) Remember that in shock hypodermoclysis is of no value by reason of its bulk, but good results accrue by virtue of its stimulant power over the vasomotor system only; (2) be careful of over-dosage; 1 dram of saline solution to each pound of the body weight in each fifteen minutes is the limit of safety; (3) employ hypodermoclysis cautiously in stout-old persons, young children and in cases of nephritis.

ENTEROCLYSIS.

Indications:

A.—Cold (70° F.): To reduce fever in sthenic cases.

B.—Hot
- (1) to promote
  - diuresis.
  - sweating.
  - alimentary elimination.
- (2) shock.
- (3) toxemias.
- (4) intestinal hemorrhage.
- (5) intussuception.
- (6) pelvic exudates.
- (7) inflammation and spasm of the pelvic viscera.
- (8) infantile convulsions.

The temperature should be 100° to 104°, if increased pulse tension is to be avoided; 105° to 108°, if increased pulse tension is not objectionable; and 110° to 120°, if a rapid increase in pulse tension and stimulation of the heart is desired.

Contraindications.—Renal disease with polyuresis.

Technic.—1. Fill a fountain syringe, irrigator or other suitable apparatus with the solution. The composition and quantity of the solution will of course vary according to the purpose for which it is to be administered.

2. Attach a rectal tube (or soft rubber catheter for children) to the free end of the tube leading to the reservoir.

3. Open the stop-cock and permit the entire length of tubing to fill with fluid.

4. Lubricate the tip of the rectal tube.

5. With the patient in the dorsal position or lying on his left side, insert the end of the tube into the

rectum, at the same time again opening the stop-cock and permitting the solution to flow slowly.

6. Gradually raise the reservoir from the level of the patient to a height that will exert the desired pressure.

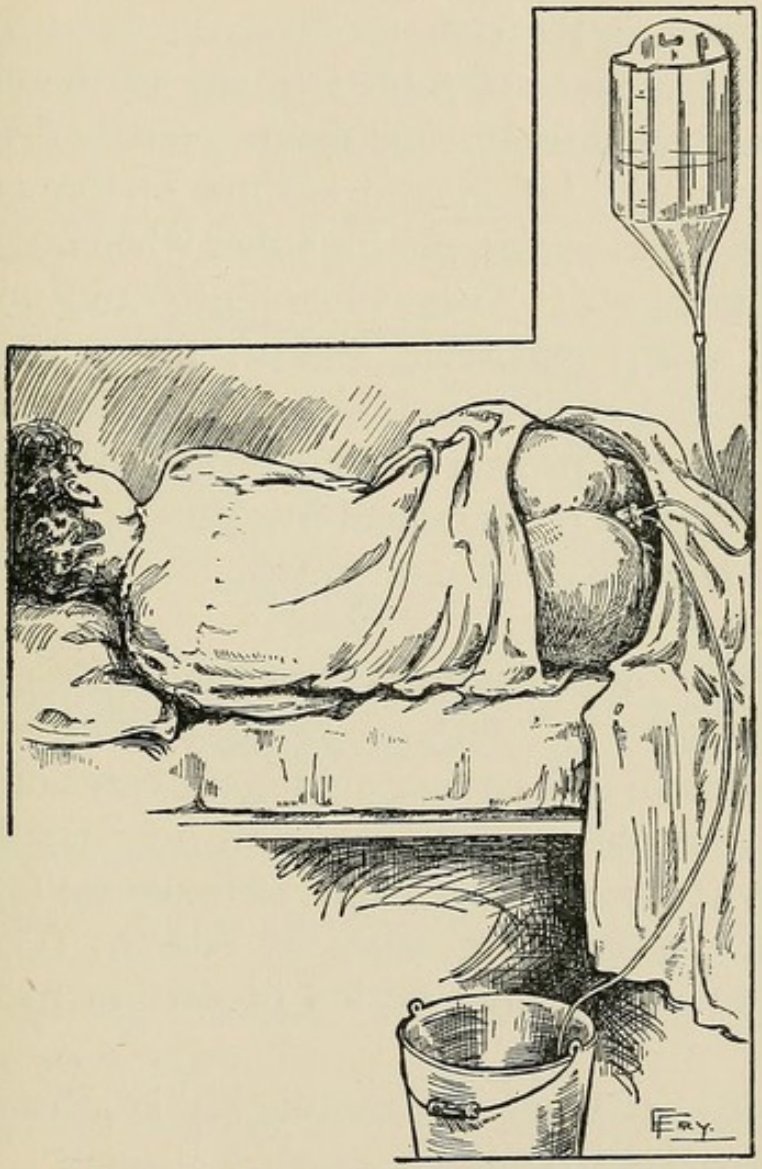

FIG. 31.—Enteroclysis with Kemp's tube.

7. When the reservoir is empty, withdraw the tube slowly.

Or

2. Attach a Kemp's return flow tube to the free end of the tube leading to the reservoir.

3. Exclude all air.

4. Lubricate the tip of the tube.

5. Introduce the Kemp's tube with a gentle rotary motion, so that the folds of the mucous membrane will not catch in its fenestrations.

6. Attach a piece of rubber tubing to the outflow channel and conduct to a suitable receptacle (Fig. 31).

7. Control the inflow and outflow of the solution by pinching the corresponding tubes when necessary.

Precautions.—(1) Always introduce fluids into the intestine slowly to avoid spasm; (2) a Davidson syringe should not be used, because the flow is intermittent and the pressure is indeterminable; (3) great pressure exerted on damaged intestine is dangerous; it should never exceed 8 pounds.

INTRAVENOUS INFUSION.

Indications.—(1) Extremely urgent cases of shock; (2) to overcome the collapse from hemorrhage; (3) for the relief of various forms of toxemia; (4) as an emergency measure in cases of edema; (5) to secure rapid and certain action of certain medicinal agents.

Technic.—1. Place the thoroughly sterilized solution in a warm irrigator.

2. Sterilize the patient's skin over one of the superficial veins near the elbow or over the internal saphenous vein.

3. Apply a constrictor immediately above.

4. Incise the skin and dissect off the sheath of the vein.

5. Ligate the vein at the distal end of the incision with catgut.

6. Pass a second ligature under the vein at the proximal end of the incision and leave it untied.

7. Exclude all air from the rubber tubing, connected with the irrigator and the cannula, by opening the stop-cock until a steady stream is obtained.

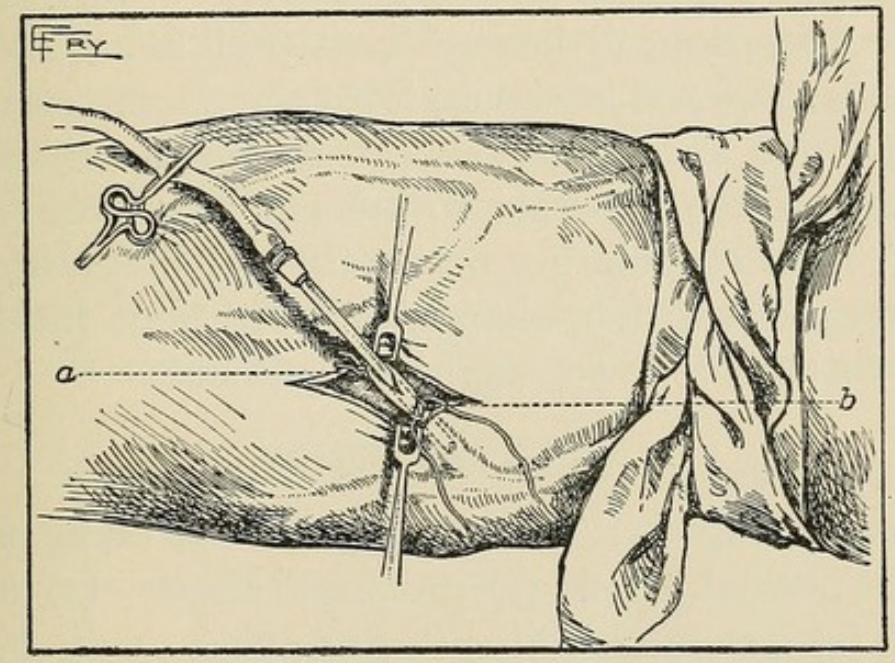

FIG. 32.—Intravenous infusion. *a*, Distal ligature tied and cut; *b*, proximal ligature tied temporarily about the vein and cannula.

8. Incise the distended vein and quickly insert the cannula, with the solution running.

9. Tie the loose ligature around the cannula and overlying vein with a single knot (Fig. 32).

10. When the cannula is withdrawn, tighten the ligature around the vein and secure with a double knot.

11. Divide the vein between the two ligatures.

12. Suture the skin wound.

13. Apply a suitable dressing.

Precautions.—(1) Taste the solution before sterilizing, if saline solution is being used; a large quantity of plain water injected into a vein will cause rapid disintegration of the red blood-corpuscles and subsequent death; (2) the temperature of the solution should never be less than 100° F.; (3) be sure that all air is excluded from the tubing and cannula and that no air enters the vein at any stage of the operation; (4) always use a well diluted solution of a drug and introduce it slowly; a quart should require half an hour; (5) dip the cannula in saline solution before inserting to prevent a few drops of blood from coagulating on its tip; (6) don't try to enter a vein with a sharp needle without incising the skin; blind surgery is never justifiable.

DIRECT TRANSFUSION.

Indications.—(1) To replace, in whole or in part, loss of normal blood; (2) prolonged shock; (3) anemias; (4) general debility; (5) toxemias.

Contraindications.—When a healthy donor cannot be obtained.

Technic.—1. Place the donor and donee on parallel tables.

2. Observe all aseptic and antiseptic precautions.

3. Secure skin anesthesia by infiltration with cocaine solution.

4. Expose and free about 3 cm. of the radial artery of the donor, collateral branches being ligated when necessary.

5. Expose and free about 3 cm. of the median cephalic vein of the recipient.

6. Place a permanent ligature peripherally on each blood-vessel.

7. Apply a Crile compression clamp, one arm being rubber shod, as near as possible to the proximal end of each exposed vessel.

8. Divide the vessels with sharp scissors, just above the distal ligatures.

9. Select a suitable sterile Brewer's glass tube, about 2 inches in length and with a slight bulbous tip at each end, which are made in various calibers and are straight, curved and angulated.

10. Immerse the tube in melted paraffin until all air bubbles cease to rise.

11. A quick sharp shake dislodges excess paraffin.

12. Remove the paraffin on the exterior of the tube.

13. Insert the smaller end into the artery and tie a ligature around it, so that the ligature lies in the groove beside the bulbous tip.

14. Release the pressure of the Crile clamp on the artery slightly, permitting arterial blood to flow.

15. Insert the other end of the tube into the vein and tie another ligature around it.

16. Remove both hemostatic clamps entirely.

17. When blood has passed for a sufficient time, ligate both artery and vein and withdraw the tube.

18. Suture the wounds, and apply a dressing.

Precautions.—(1) Direct transfusion should not be attempted by the inexperienced, as a slight error may prove disastrous; (2) when feasible, it is wiser

to supply arterial than venous blood; (3) test-tube phenomena being fairly reliable, make a preliminary test of the blood of both donor and donee to avoid possible hemolysis; (4) don't use hemostatic clamps that exert great pressure and injure the walls of the blood-vessels; the pressure should be just sufficient to obstruct the blood current temporarily; (5) merely dipping the Brewer's tube into liquid paraffin will not insure complete coating of the lumen; (6) general anesthesia is permissible but local anesthesia advisable; (7) watch the condition of both patients carefully; (8) in case of threatened syncope, place the donor in the Trendelenburg position; (9) it is impossible to accurately guage the amount of blood transfused, but pronounced increase of cardiac dullness or sudden dyspnea in the recipient is indication for cessation.

CATHETERIZATION.

Indications.—(1) To determine the contents of the bladder; (2) to withdraw urine in emergencies; (3) to evacuate blood-clots, fragments of stone or foreign bodies; (4) to cleanse the bladder; (5) to introduce medicaments; (6) as a preliminary to abdominal operations; (7) to distend the bladder with water or air; (8) to establish continuous vesical drainage; (9) as a diagnostic measure.

Contraindications.—(1) Impermeability of the urethra; (2) suppression of urine.

Technic.—1. Patient recumbent.

2. Select the largest soft-rubber catheter that will readily pass the external urinary meatus.

3. Cleanse and sterilize the hands of the operator, instrument and glans penis.

4. Retract the foreskin and grasp the glans with the thumb and forefinger of the left hand, directing the penis so that it points to the median line of the anterior abdominal wall.

5. Holding the catheter 2 or 3 inches behind its tip, dip the tip in a sterile lubricant and insert gently into the meatus.

6. Propel the catheter forward about a quarter of an inch at a time.

7. As the tip enters the membranous urethra, depress the distal end of the instrument and as the tip enters the bladder the exposed end should lie parallel with the extended thighs.

8. If an obstruction is encountered during the passage of the instrument, it should be slightly withdrawn and another effort made to pass it. An impassable barrier will necessitate the use of a catheter of smaller size or one of metal, depending upon the existing circumstances.

Precautions.—(1) Be sure that the soft-rubber catheter is not hard and brittle; (2) a rigid catheter, in inexperienced hands, is a dangerous instrument and should not be employed unless the soft-rubber one fails and patency of the urethra is certain; (3) the utmost gentleness should be observed in passing catheters; they cannot be forced through the urethra without danger; (4) a false passage is evidenced by sudden obstruction and great pain; hemorrhage follows withdrawal of the instrument; (5) patience and gentle persistence will overcome spasmodic stricture;

(6) continuous catheterization is preferable to frequent introduction and withdrawal; (7) the catheter should fill but not dilate the urethra; (8) catheterization will dissipate many abdominal "tumors"; (9) don't try to catheterize women by the sense of touch only; infection or injury may be the price of false modesty; (10) a preliminary dose of hexamethylenamine is an excellent prophylactic measure, as it renders the urine more or less aseptic.

VACCINATION.

Indications.—(1) As a prophylactic measure in the prevention of small-pox; (2) to attenuate the virulence of an attack of small-pox; (3) to propagate the virus of vaccinia.

Contraindications.—(1) Impaired general health; (2) acute diseases other than small-pox.

Technic.—1. Select and surgically cleanse a suitable site on the skin, being careful to avoid the bellies of underlying muscles. The insertion of the deltoid muscle and inner condyle of the femur are the locations usually chosen.

2. Stretch the skin, with the forefinger and thumb of the left hand.

3. Make a number of criss-cross scratches on the skin, denuding an area about a quarter of an inch in diameter, of its superficial epithelia, with a scarifier or steel needle, which has been sterilized by passing through a flame.

4. Break off the end of a small aseptically sealed capillary tube containing glycerinated animal lymph.

5. Attach the section of small rubber tubing which accompanies the glass tube to its free end.

6. Break off the other end of the glass tube.

7. Blow through the rubber tube, depositing the virus on the scarified area.

8. Rub in gently with the instrument.

9. After drying thoroughly, apply a suitable shield.

10. If unsuccessful, revaccinate in two weeks.

Precautions.—(1) If the virus is inoculated over a muscle, the region is irritated by the movements of the muscle; (2) large and multiple denudations are unnecessary; (3) the skin should be scratched until lymph exudes but never deeply enough to cause bleeding; (4) the virus should be active and free from other pathogenic organisms, not long in stock and kept in a cool place; (5) the virus obtained in the hermetically sealed tubes is likely to be cleaner and more potent than that dried on ivory points; (6) the patient's underclothes must be clean; the shield may be dispensed with in patients whose habits are cleanly.

SKIN-GRAFTING.

Indications.—(1) To cause prompt healing of large granulating surfaces, preventing the deformities that result from natural reparative processes and subsequent contraction of the scars; (2) to replace scar tissue with a soft pliable integument; (3) plastic operations.

Contraindications.—Devitalized or necrotic surfaces.

Technic.—1. Wash the granulating surface with saline solution and dry with sterile gauze.

2. Cleanse the area from which the grafts are to

be taken with soap and hot water and flush with saline solution.

3. Select a keen edged razor, ground flat on one side.

4. Sterilize the razor by immersing in alcohol for ten minutes.

5. Wrap the thumb and forefinger of the operator's left hand in sterile gauze and stretch the skin.

6. Cut a thin graft from the stretched skin with a quick sawing motion of the razor, being careful to remove the epidermis only.

7. Transfer the grafts directly from the razor to the granulating surface.

8. Repeat until the entire area is covered, the grafts over-lapping each other and the skin margins. They may be teased into position with a sterile probe.

9. Press out all air bubbles with the probe.

10. Cover with a strip of sterile gutta-percha tissue and leave for a week.

11. Cover the gutta-percha tissue with a generous layer of sterile gauze wrung out in hot saline solution.

12. Change the wet gauze daily, being careful not to disturb the gutta-percha tissue.

Precautions.—(1) Don't graft until healing has begun and the surface is well granulated; (2) trim off exhuberant granulations with a sharp razor; (3) take the skin from the patient himself when possible; (4) never employ local anesthesia; if anesthesia is absolutely necessary, use a general anesthetic; (5) skin-grafting must be an aseptic operation; antiseptics are contra-indicated.

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