# SURGICAL TREATMENT OF WOUNDED MEN AT ADVANCED UNITS.

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## *An Outline.*

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It is impossible to convey on paper anything but the feeblest impression of what the conditions for surgical work are at a very advanced unit during a big "push." For the surgeon who comes fresh from the choice surroundings of palatial, well ordered hospitals, who has hitherto had all things made easy in virtue of his training and surroundings, and who may be so cocksure of good results that he dreams of performing marvelous operations at the front and that men will stand dumbfounded at his skill, for him there will be much to learn and much to unlearn. The place he takes in the military scale of things, the conditions of his work, the dimly lighted dugout dressing station, the curtailed facilities, the dust, the wet, the sweat, the mud, the blood, the noise, the bustle, the numbers of wounded, the appalling wounds, the hopeless shock will open his eyes, test his capacity and resource, and tend to break his heart as never before. Here is no brilliantly lighted and fully equipped theatre, here his patients do not come before him in spotless apparel, here he has not unlimited skilled assistance, here no aseptic ritual is possible, here he must be content with very simple things. And through it all he must keep cool, he must hurry, he must be thorough, he must be gentle and careful in every possible way. His is the responsibility to make or mar a man for life. Often his patients, shattered in nerve as well as in limb, can give but

feeble response to his utmost efforts, so that a little slip in judgment, a little unnecessary exposure for them, a little lack of ordinary comfort even, or a little rough or unconsidered handling will tip the scale and send them to that death which their foes have desired. The same remarks in a modified way apply to units farther back.

What an opportunity! What a necessity for each equipping himself as best he can so that he may give of his best to those who deserve it more than ever men did! In so far as we fail to accommodate ourselves to these unavoidable conditions or neglect opportunities of acquiring for ourselves or imparting to others the special knowledge which will help our wounded men and fail to put that knowledge into practice, so far do we fail in duty to our country. These papers represent, in a modest way, a desire to help. They form a plain unvarnished statement of what a varied experience of three years leads me to think are the best methods of treating the wounded man from a professional point of view. Administration is not dealt with although administration cannot be dissociated. Any attempt to divorce administrative from professional work is fraught with great danger to the success of our calling. If the administrator neglects the advice of his clinical brother his faulty administration may result, during a big battle, in the loss of literally hundreds of lives and of limbs which would otherwise have been saved.

In a communication such as this one cannot enter into details with regard to all procedures or types of injury. Some are described more fully than others for various reasons. One is impressed by the fact that the methods of treatment which are most successful are those which are simplest and which follow the indications of Nature most closely. The man who can land his patient at the next destination in best condition with the fewest contraptions serves best his country. Some measures

described are so simple that were they not so frequently neglected, one would not be justified in drawing special attention to them. Principles of surgery remain the same, but the application of them is perforce adapted to local conditions. Original minds will always devise the means to the end in the greatly varying and new conditions which this war will continue to force upon them. The surgery of the field ambulance, of the casualty clearing station, of the hospital on the lines of communication in France, and of the base hospitals at home differ widely from each other. Even the most skilful hospital surgeon of civil life must pass through an apprenticeship at any of these places before he becomes of the same value as his house surgeon of three years ago who has qualified in war surgery in France. Even three weeks' experience makes a wonderful difference in one's ideas.

*The importance of preventive work.*—As indicated, enormous difficulties beset advanced work, especially during severe fighting. The conditions of warfare demand, to put it bluntly, that wounded men shall be got out of the way so that supplies of reinforcements, ammunition, and food to the fighting line are not interfered with. But while the primary function of advanced medical units is to clear the wounded as rapidly as possible, yet the enormous importance of preventive work must constantly be kept in mind. The effects of treatment of the wounded man at the earliest stages are reflected in the whole course of his subsequent illness. The influence of efficient early treatment cannot be overestimated. The prevention of early complications gives a man a good start in his struggle for life and limb. Only the most necessary procedures can be carried out, but these must also be the best possible. Intercommunication with units farther back will alone insure efficiency and improvement. Reports as to the condition in which

COMPARISON OF NAMES OF UNITS.

| *American.* | | *British.* | |
|---|---|---|---|
| 1. Regimental dressing station | = | 1. Regimental aid post—R. A. P. | |
| 2. Ambulance | = | 2. Advanced dressing station—A. D. S. | Field ambulance |
| 3. Field hospital | = | 3. Main dressing station—M. D. S. | |
| 4. Evacuation hospital | = | 4. Casualty clearing station—C. C. S. | |
| 5. Hospital train | = | 5. Hospital train. | |
| 6. Base hospital | = | 6. Base hospital, "Stationary" or "General." | |

patients arrive there should be furnished and treatment at the more advanced units should be amended, if necessary, according to the indications given. The three great factors for evil which have to be combatted in these early stages are shock, hemorrhage, and sepsis.

*Shock.*—The intense surgical shock from which some of the wounded suffer must be seen in order to be appreciated. Primary shock from the injury is aggravated by unavoidable early handling and by transport of the patient. This fact is brought home to us in a negative way by the observation that a man with a fractured femur who lies out for a day or two after being wounded, arrives at the casualty clearing stations in better condition on the whole as regards pure shock than those who are picked up and transported without delay. A comparatively smooth railway journey has a deleterious effect. How much worse is the effect of transport down uneven trenches, over rough country, and along bumpy roads! A wounded man left lying out keeps his limb at rest and recovers from the first shock of the injury. We must pay close attention to these indications because other considerations compel the immediate removal of the patient to a place where he can be operated upon to the best advantage. We must prevent the summation of painful stimuli, which transport inevitably provides, from producing shock, and this from being, when superadded to shock already present, too much for the patient's endurance. The most important elements in combatting the development of profound general secondary shock are rest and warmth. Rest during the journey is procured by proper fixation and efficient support of the injured part and prevention of jarring bumps. Complete rest to the patient is out of the question at this stage and therefore the aid of sedatives has to be invoked, and should be used as early as possible in order to render him less sensitive. Morphine is very valu-

able, but its purely depressing effect on the vital centres and on metabolism, which are in these cases already too often at a low ebb, constitutes a disadvantage. Omnopon, or any similar extract of opium under a different name, is preferable, because this depressing effect is not manifest to anything like the same degree. Two thirds of a grain of omnopon is equivalent in sedative action to about one fourth to one third of a grain of morphine. At this point one may say that much of the benefit of the sedative is lost if the patient is at once sent off on his journey. He should be detained, if possible, for fifteen minutes or more, until the injection has taken effect. Every dose of morphine or omnopon and the time at which it is given, should be noted on the field medical card. One cannot say that any other treatment of shock hitherto tried at this stage has proved of much value.

The position of the patient during transport is often important in that it may obviate a sudden jar from an uneven road. For example, a patient with a fractured humerus will often ride more comfortably sitting than lying. Jolting is dissipated by his yielding body before it reaches the arm. In the same way some head patients with considerable, though unsuspected, damage to the brain often arrive as "sitters" in extraordinarily good condition. Sudden sharp bumps or lateral movements of the head are particularly bad in cerebral injuries. Such patients must usually be sent lying down. An extra pillow or folded blanket should be put under the head and, especially if the man is unconscious, side supports should be used to prevent coarse lateral movements during lurches of the car. In the case of fractured femur the Thomas's splint should be slung in some way for similar reasons.

*Acute sepsis.*—Shock, hemorrhage, and acute sepsis react on each other in marked fashion. The sepsis we have most to fear in very early stages is caused by gas forming bacilli. Gas gangrene de-

velops most rapidly in parts which are deprived of circulating oxygenated blood; witness the extraordinary rapidity with which the whole body becomes affected after death. Gas bacilli thrive best in lacerated, devitalized muscular tissue. An injury which wounds a muscle or group of muscles and simultaneously cuts off the blood supply paves the way for rapid gas infection of the whole muscular tissue involved. Pressure of a blood clot renders the walls of the wound anemic. Inflammatory effusion, both liquid and gaseous, soon completes a steadily widening vicious circle. If gas bacillus is present in a wound, shock or severe hemorrhage predisposes to the development of the infection owing to the slowing and enfeeblement of the circulation. If the main vessel of the limb is injured the danger is still greater, because efficient collateral circulation is so delayed that before it is established the infection often obtains a firm hold. Prolonged use of a tourniquet has sometimes a disastrous effect. A further trouble is that shocked cases frequently slide rapidly into a condition of profound toxemia. The patient is too often with the devil and in the deep sea!

*Hemorrhage.*—One need not do more than draw attention to the fact that hemorrhage predisposes to shock and will aggravate shock already present. On the other side, the only good thing that can be said of shock is that by enfeebling the circulation it may prevent so great a loss of blood as might otherwise occur. Always remember that every ounce of blood is of the greatest importance to the wounded man. An extra ounce lost may be like, although in an inverse way, the fatal straw on the back of the camel.

*Shock in slightly wounded.*—Such remarks apply to all severe wounds, but you will be impressed by the number of slight wounds in which the element of shock becomes manifest, sometimes in a very marked degree. It is remarkable also how in some

patients shock suddenly develops, especially during transport, for no evident reason. It seems that their power of endurance suddenly breaks down. Such men are often of a highly strung nature, excitable and talkative while being dressed. They do not usually complain of pain and there may be no hemorrhage or other shock producing factor present. It may be that a sufficient injection of sedative will prevent the onset of such shock. I believe that "shell shock" plays a large part in these cases, and is a contributory cause to the somewhat sudden death which may occur later. The surgical lesion

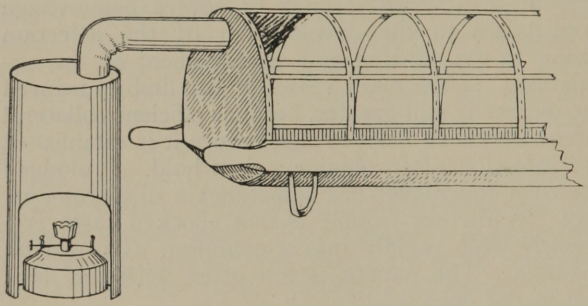


FIG. 1.—Improvised apparatus for warming patients rapidly. The stove is made of an ordinary oil drum in the side of which a hole is cut. The cradle is made of aluminum straps ordinarily used for making splints. The end is closed by tin sheeting through which the stove chimney projects slightly. Tin also covers part of the top of the cradle. When in use the cradle is covered by blankets. Quite a small lamp suffices.

*per se* is not sufficient to explain the death. Other gross organic lesions of hitherto recognizable type are also absent.

*Fluid nourishment.*—The exertions and experiences which these men have come through make a great demand upon their vitality. It is therefore necessary that they should have food and drink in plenty and of an easily digestible nature. In serious cases digestion seems sometimes to be inhibited. Wounded patients, who are likely to be operated on when they arrive at casualty clearing stations, should be given only warm fluid nourishment. Hot

tea is probably the most favored beverage. In a case of severe shock, it is not much good giving the patient even drinks until he has been warmed up. If they are given he will probably vomit and the exertion of doing so is bad for him.

*Warmth.*—All wounded men in winter and most seriously wounded men even in summer are apt to suffer from cold. All possible precautions and remedies must be taken against this. Especial care should be exercised in dressing rooms, where patients' bodies are un-

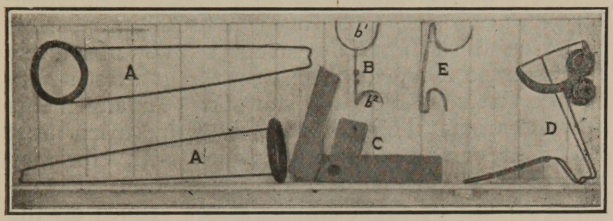



FIG. 2.—Arm splints. $A^1$ $A^2$, small Thomas's splints, right or left. In $A^2$ the ring has been turned over so that the arm may be brought to the side during transport. The ordinary form, $A^1$, necessitates support of the upper extremity in an abducted position. B, modified Depage humerus splint, right or left. Telescopic adjustment is possible. The crutches, $b^1$ $b^2$, rotate so as to allow more accurate adjustment to the axilla and forearm. A narrow sling supporting the wrist keeps the elbow flexed to less than a right angle so that the splint does not usually require fixation by bandages. C, Bowlby's wooden angular splint, right or left, with hinged posterior shutter. D, Jones's extension splint for humerus, right. E, extemporized splint made of aluminum strap, left, applied in same manner as B.

covered in order to have their wounds dressed. Stoves are not much use if draughts blow in through imperfect walls, windows, or open doors. Hot water bottles and heated ambulance cars have saved many lives. The soldier's water bottle makes a good substitute for the ordinary hot water bottle. The curtains of the ambulance cars should be closed in cold windy weather except when a patient is actually being loaded. Blankets may have to be pinned or otherwise fixed on restless patients or during transport over particularly rough roads. Remember that cold strikes through the canvas of the stretcher.

The apparatus shown in the accompanying sketch (Fig. 1) provides a very useful means of rapidly warming patients at advanced and main dressing stations. It will be appreciated that the best results in resuscitating bad cases are got by those who give the greatest attention to all the points mentioned. At the same time fussy interference cannot be too much deprecated. Do what is absolutely necessary and then leave the patient alone.

*General treatment of wounds.*—Patients cannot be kept long at field ambulances. Owing to the numbers of patients who pour through field ambulances during severe fighting it is usually impossible to do anything for them except what is absolutely necessary to carry them on with the greatest safety to the casualty clearing stations. Arrangements for operations, the splints and dressings used must be of the simplest form combined with efficiency and must be capable of rapid application. Everything should be practised in "peace" times on the same plan as is to be carried out in "strafe" times, so that when severe fighting occurs everyone knows exactly what to do. Speeding up of peace procedures is then all that is necessary. It is difficult for inexperienced officers to realize that wounds which look fairly clean are really so hopelessly and virulently infected as the ordinary shell wounds in France are. The general principles in dealing with such wounds will be discussed in a later article. These principles cannot be applied satisfactorily in a field ambulance during heavy fighting. It is necessary to emphasize strongly at this stage that wounds must not be closed either by suture or by occlusive dressings. The infection which is carried into these wounds develops often at such a rate that in a few hours patients may succumb to its virulence. These effects are delayed when a few loose folds of gauze, preferably impregnated with some antiseptic of prolonged action, are inserted so that the surfaces of the wound in the depth, as well as the skin edges, are kept apart. Previous to this, of course, clot

and gross infective material should be rapidly removed. Care must be taken that "corking" of the

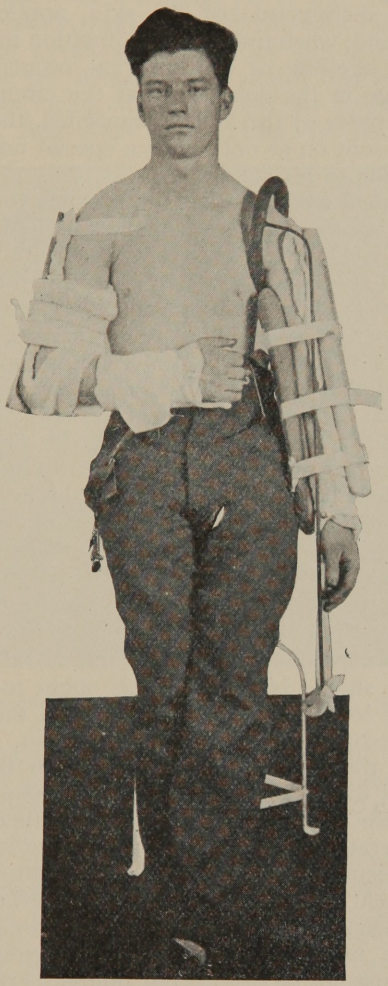


FIG. 3.—Application of Bowlby's splint, right; a spica bandage around the shoulder and sling have been omitted. Thomas's small splint for transport, left. In the latter, the patient is sent down as a "lying" case.

wound by this gauze does not occur, so as to cause retention in the depth.

*Small entrance and exit wounds caused by undistorted rifle bullets* require usually no further attention than disinfection of the skin, application of dressing, and, when time permits, fixation in a splint. If severe swelling of the limb has occurred from hemorrhage in the depth so that the circulation in the distal parts of the limb is imperiled, the patient should be sent on at once with a special note drawing attention to his condition.

*Minor shell wounds.*—It is impossible to estimate by inspection the depth to which a missile has penetrated. If, however, the wound admits a finger the wound may be explored by it, and if the foreign body is felt at a depth of not more than one and one half inches the wound may be opened up and the foreign material, metal, clothing, etc., removed. At the end of the operation the wound should always be wider at its orifice than in the depth. In such wounds Bipp, recommended by Professor Rutherford Morison, or one of the recently introduced nonpoisonous antiseptic pastes should be smeared on and a fold or two of gauze inserted in the wound. Such operations can usually be done without the aid of chloroform or ether. Nitrous oxide gas anesthesia or infiltration of the line of incision with local anesthetic is preferable.

If a foreign body cannot be felt no attempt at extraction should be made. This ought to be done only after localization by x ray. Even though the foreign body can be felt under the skin, if it has traversed the soft parts for more than the above mentioned distance it should be left alone, for removal at the casualty clearing station, otherwise the major operation involved is apt to be either unfair to the patient under the unsuitable conditions or to be inefficient in removing infection. Where fracture has been caused, also, no operative interference should be made. Even such interference as described must not be carried out unless there is sufficient time to carry it out thoroughly. It must be remembered that such minor wounds are really of

great military importance, because while they are at first comparatively trifling, yet if not treated early and efficiently, preferably at casualty clearing stations, the development later of gas infection may entail the performance of a major operation which of course incapacitates the patient from duty for a longer time than would otherwise be necessary.

FIG. 4.—Application of Depage's splint, right, and improvised aluminum or strong wire splint, left.

Such operations should therefore only be done at the field ambulances by a competent surgeon who has had considerable experience of casualty clearing stations or base hospital work.

*Large gaping wounds* should be cleared of clot and foreign material and gauze made up with antiseptic as described laid loosely into the recesses. Particular care should be taken not to close down flaps of tissue without such gauze having been previously placed under the flap. In this type rapid incision with a scalpel will often be of greatest assistance in allowing this gauze packing to be done

effectively. The important thing in these wounds is to prevent the apposition of infected surfaces. All visible foreign bodies or displaced loose fragments of bone should be removed, whatever the type of the wound, especially in those in the neighborhood of large vessels and those which project into joints or from the surface of the brain. It is evident that during transport these would increase the amount of damage done or even cause fatal hemorrhage. It is of the greatest importance to support large wounds of the extremities by splinting material. Hemorrhage, effusion, pain, and development of sepsis are thereby minimized.

*Dressings and antiseptic applications to wounds.*—Plain sterile gauze and wool are the best for a field dressing. Infection is carried deep into the wound by the missile and after the skin has been disinfected no superficially applied antiseptic has any effect in preventing the development of such infection. There is doubt that mere syringing through with antiseptics is so beneficial as some think. It may actually distribute the infection to parts previously uninfected. Dressings impregnated with mercurial preparations have been the cause of severe blistering when applied after the skin has been painted with iodine. Such medicated dressings entail unnecessary expense. Sterile gauze can be impregnated on the spot, if thought desirable. Picric acid, three per cent. in alcohol, has been found superior to tincture of iodine for early application to these wounds and has entirely replaced its use in most hospitals immediately behind the line for general disinfection of the skin. If soap and water and picric acid solution are available, no other of the ordinary antiseptics need be provided for work at field ambulances during a battle. Pastes made up with paraffin, containing antiseptics in different proportions and varieties, may be used to great advantage at this stage for smearing the inside of the wound. Bipp—bismuth subnitrate, one part; iodoform, two parts; liquid paraffin, q. s. to make a

thin paste—has been popular and wonderfully efficient, but it is desirable, at all events in recent wounds, that less poisonous substances should be used. Pastes made with brilliant green or flavine, chloramine-T, and boric acid have given good re-

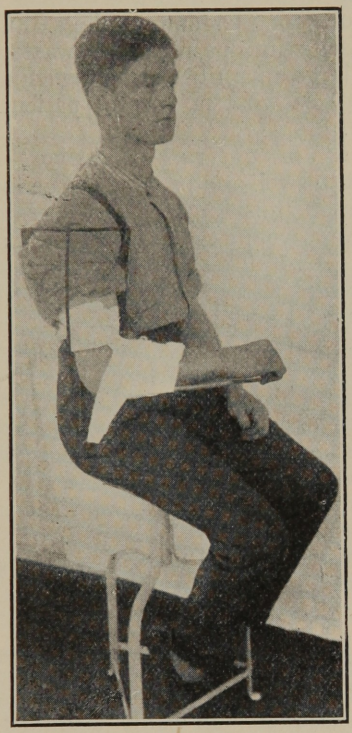


FIG. 5.—Application of Jones's extension humerus splint. The shirt sleeve has usually to be cut away.

sults, as also has a one per cent. solution of iodoform in liquid paraffin. The last is used to saturate the gauze which is inserted into and covers the wound. It can be used alone or in conjunction with a paste.

Watery solutions of antiseptics, such as eusol,

Dakin's fluid, etc., have too evanescent an effect to be of great value in a gauze dressing, while Carrel's method of applying them is unsuitable for many reasons, one being the paraphernalia required. Sphagnum moss dressings are very useful. They are made up in pads which are suitable either for dressings or for padding splints. Cottonwool should be used with due regard to wastage. When applied in large quantities dressings may prevent the discovery of what is, for the patient, a severe hemorrhage.

*Precautions in applying dressings.*—Wounded parts are apt to swell and because of the interference with circulation thus caused, very serious results may follow in a wound which would otherwise have been slight. It has been found of great importance to support large and deep flesh wounds with splints even though no fracture is present. It is desirable that the encircling bandage be put on after the splints have been placed in position. If extension is applied to a fractured limb this should be made before bandages are applied around the wound. This precaution is taken chiefly because of the swelling which supervenes but one has heard of fatal results following inattention to it in case of fractured femur. The application of extension sometimes dislodges clot occluding a large artery, and in these cases the hemorrhage was obscured by the bulky dressing until too late to save the patient.

*Avoid frequent change of dressings.*—Patients have been needlessly annoyed by too frequent dressing of their wounds. In badly wounded men the extra pain and disturbance will tend to produce or aggravate shock. Routine interference at every stopping place means waste of time and material and of the energy and endurance of the patient. Without definite indications, therefore, no dressing should be changed. Generally speaking, these indications are the presence of: 1, A first field dressing, usually applied over a dirty or imperfectly disinfected skin.

In some cases, however, when the dressing is dry and the patient's skin apparently clean in the neighborhood of the wound, the dressing need not be disturbed; 2, soaking of dressing with blood, mud, etc.; 3, unsuitable or imperfectly applied splints; 4, too tight bandages which interfere with circulation, causing swelling and pain; 5, too loose bandages which do not support the wounded part and are allowing the dressings to slip; 6, increasing pain in the part, which may indicate hemorrhage in the depth or the onset of gas gangrene. In either

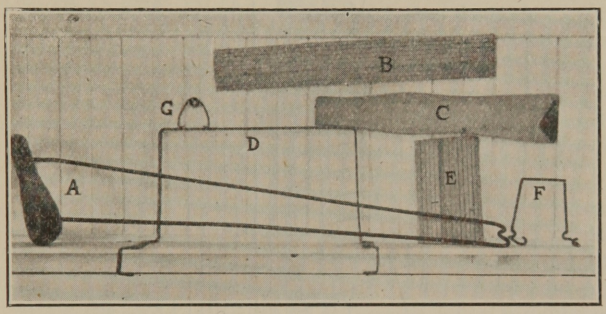



FIG. 6.—Thomas's splint outfit. A, Thomas's knee splint. B and C, supporting back splints. B, Gooch's splinting. C, a shaped "ham" splint. Jones's metal gutter fracture splints, padded with felt, largest sizes, are even more suitable in many respects. D, stretcher suspension bar or frame. E, short piece of Gooch for anterior thigh splint. F, strong wire footpiece. G, Tapson's heel clip from which extension is made.

case the patient should be hurried to the casualty clearing station with a chit or specially colored label drawing attention to his condition.

*Operations at aid posts or dressing stations.*—It is not advisable under the conditions of this war to make elaborate arrangements for serious surgical operations on patients within the zone of ordinary shell fire, therefore as a routine only such operations as are absolutely necessary should be performed in units in front of casualty clearing stations. Operations for hemorrhage which threatens life and those

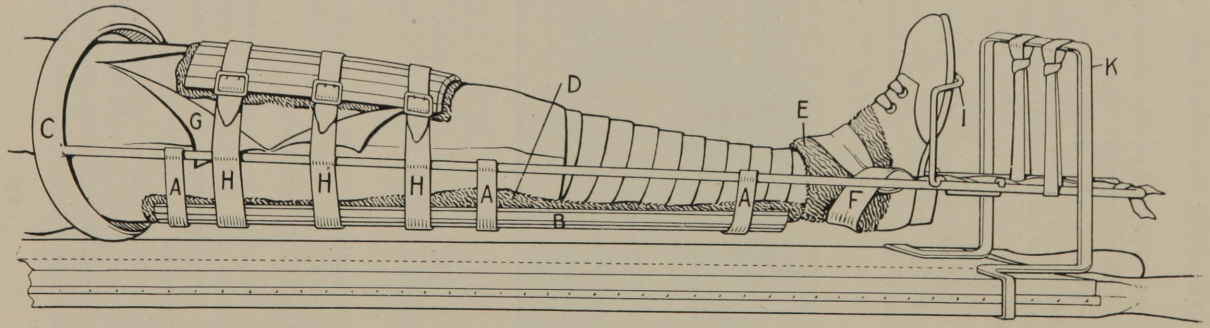



FIG. 7.—Diagram of Thomas's splint outfit applied, without removal of trousers or boot. A, adhesive plaster slings; B, supporting splint; C, Thomas's splint; D, pad graduated so as to cause slight flexion at knee; E, pad round ankle; F, clove hitch round ankle tied over notch at end of splint; G, trousers cut away to expose wound; H, splint straps fixing anterior thigh splint; I, footpiece; K, suspension bar over which two suspensory slings are tied.

for the removal of hopelessly smashed limbs are the only ones which ought to be done.

*Amputations.*—Hopelessly smashed limbs which tend to bleed much or which are attached by mere shreds of tissue should be removed. Detachment of the part can often be effected by a few snips of a scissors. Retention of a shattered foot may lead, owing to the pain from dragging and so forth, to severe shock. If the pressure of work is very great all that need be done is to control hemorrhage, and clean and pack the ragged stump with prepared gauze. Even when a more elaborate trimming of the stump is possible suture of the flaps is rarely attended with success; in fact it has repeatedly led to death of the patient from sepsis. Secondary suture when the wound is clean is the safer procedure. This can often be done in a few days if development of sepsis is prevented by careful application of the dressings recommended.

*Operations for hemorrhage.*—These are sometimes extremely difficult and may demand great daring, but it must be remembered that the patient will die very shortly if active hemorrhage is not checked satisfactorily. Application of a tourniquet for long periods may produce ordinary gangrene, it predisposes to gas gangrene, and always causes pain. Therefore if, because the case is a difficult one and a casualty clearing station is not far distant, the patient is sent on for operation there, the transport should occur without loss of time and a special orderly should accompany the patient in order to control the tourniquet. Sometimes a ligature cannot be applied easily to a vessel which has been caught up by forceps. If the wound is complicated or is a very deep one the patient should be sent on with the forceps *in situ*. Arrangements must obviously be made for the immediate return or exchange of tourniquets, forceps, and other special appliances so that the field ambulance may not suffer for want of them. A type of wound, which, though possibly

not severe, has frequently led to very serious results, is one from which steady oozing occurs. The medical officer who first sees such a case may have applied compression and voluminous dressings in the hope that the oozing will stop. The soaked dressings are removed by the next medical officer who sees the patient and who reasons in the same way. This may occur even a third time, so that although at no time is the bleeding at all alarming, the patient arrives at the casualty clearing station in a collapsed and anemic condition, having lost in the aggregate a large amount of blood. Such wounds should be opened up and the bleeding, which is usually venous

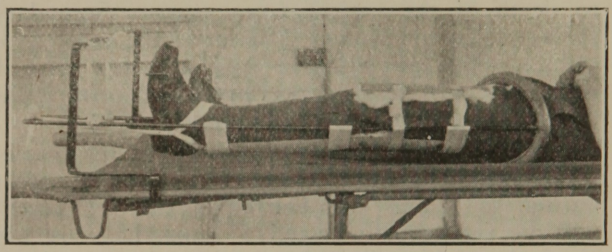


FIG. 8.—Thomas's splint outfit applied without removing trousers or boot. The supporting splint should have been placed a little higher up the thigh.

in origin, controlled. In such cases gauze packed directly on the bleeding surface may be the best remedy.

*The use of general anesthetics.*—If this is necessary patients should, if possible, be kept for at least twelve hours until they have thoroughly recovered from the effects. Chloroform and, to a less extent, ether predispose to shock; therefore, if the patient is subjected to the comparative rough and tumble of an ambulance journey before their effects have passed off, shock will very readily occur. At casualty clearing stations patients are kept until the effects of general anesthetics have passed off before being despatched even in a smooth running train.

General anesthetics are usually unnecessary for "scissors amputations" and for the most of the minor wounds which it may be necessary or justifiable to open up at advanced units. Where deep hemorrhage is occurring the patient should have a general anesthetic. Gas apparatus is out of the question except possibly at main dressing stations or at a few favorably placed advanced dressing stations. It is probably less deleterious to the patient in the long run to cause him short severe pain than that he should run the risk incumbent on the use of

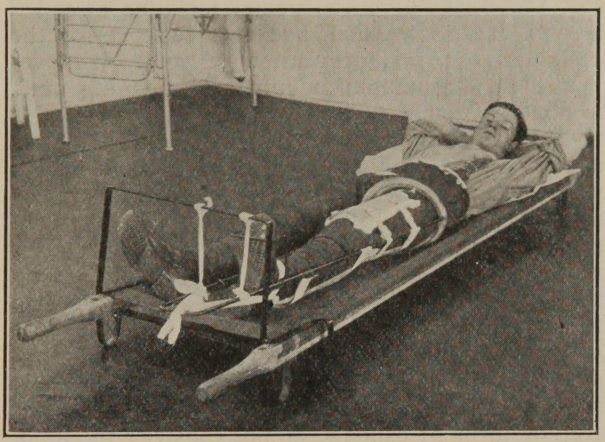


FIG. 9.—Thomas's splint outfit applied without removing trousers or boot.

general anesthetics. When, for example, setting a fractured femur has to be done, a suitable injection of morphine may be given if necessary and until it has taken effect the patient is left for ten or fifteen minutes, during which time other patients can be attended to. Less than one fourth grain of morphine is rarely of any use.

*Fractures.*—For transport purposes those splints in which it is possible to apply selfcontained extension are to be preferred. The best example of these

is Thomas's knee splint. The simplest splints are usually the best and they should be capable of adjustment with the least possible general disturbance of the patient. When fractures are handled a pull on the affected limb should always be kept up so that the fractured surfaces are prevented from rubbing together unduly. It is rarely necessary to administer anesthetics for setting fractures. The opposition of wounded muscles to reduction of deformity is usually easily overcome. In order to provide greatest comfort for the patient during transport the following three points must be attended to: adequate extension, adequate support for the wounded part, and prevention of rotatory movements. The minimum amount of bandaging must be done so that easy readjustment of the splint is possible. Tapes with buckles are often all that is necessary. Long splints ought to be prevented from becoming displaced by fixing them to the skin, or possibly, as in the case of fractures of the thigh, to the Thomas's splint. A strip of adhesive plaster round the lower and upper extremities of a long straight splint will usually be sufficient. The strip may encircle the limb on the distal side of the wound, but proximal to the wound should be applied spirally or in an incomplete circle and not tightly. Care must be taken that the proximal splint strap or turns of bandage do not constrict the limb. A variety of splints must be provided for each limb on account of the varying situation and size of the wound as well as variation in site and extent of the fracture. Amputations for fracture at field ambulances should only be done when vessels and nerves are also destroyed or if gangrene on the part distal to the fracture has already occurred. As a general rule mere smashing of bone, even with extensive laceration of muscle only, is not sufficient justification for early amputation.

*Fractures of the humerus.*—The splints and their method of application shown in the photographs are those which have been found to be the most valu-

able. If the small Thomas's splint is used, a well padded anterior and posterior splint should be added for support. For fractures of the shaft, Depage's modified splint is practically always applicable. Jones's extension humerus splint has also been used fairly frequently. If a wound prevents the application of these two, Bowlby's wooden angular splint is then probably as good as any. For fractures at or near the elbow, whether of forearm bones or humerus, the small Thomas's splint is the best. For

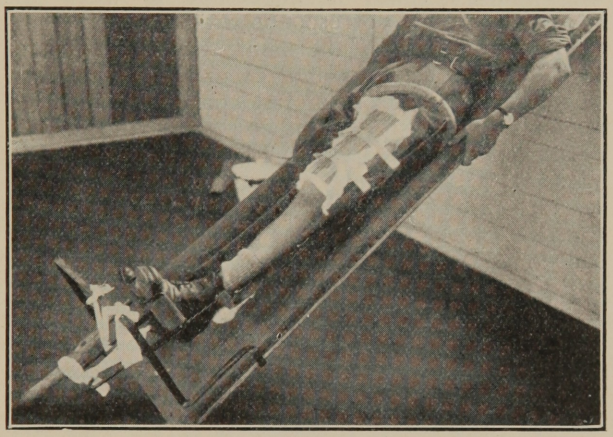
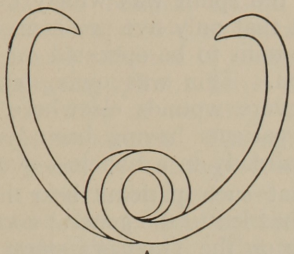


FIG. 10.—Thomas's splint outfit applied without removing trousers or boot. In the absence of a suitable supporting splint, the leg of the trousers has been split down the front and pinned over each bar of the Thomas's splint. Tapson's clip extension is used in this case. The stretcher has been tilted in order to show details.

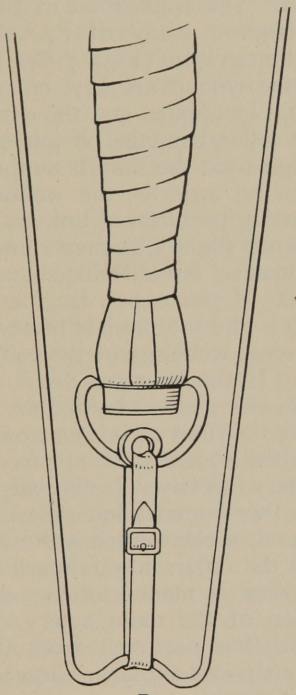
transport on a stretcher this splint is bent as shown over the edge of a table or stretcher handle, or is provided with a swivel at the ring. A very efficient splint can be made rapidly by bending a strip of thick aluminum or thick wire in the way shown in the photograph; the crutches must be turned at right angles to each other according to the side for which it is used (Figs. 2, 3, 4, and 5).

*Fractures of the femur.*—Thomas's splint outfit

consists of (Fig. 6): 1, Thomas's knee splint; 2, a posterior supporting splint, as Gooch's splinting, a wooden "ham" splint, or Jones's metal gutter splint; 3, a short anterior splint for the thigh; 4, a strong wire footpiece, for preventing wobbling of the foot; 5, a stretcher suspension bar; 6, one inch adhesive strapping, bandage, or splint tapes. This has proved to be the best method of preventing shock and should be used as soon as and whenever possible. The only occasion on which the use of Thomas's splint is impossible is when the site of the wound corresponds with the back or inner part of the ring of the splint; that is, if a wound of the lower part of the buttock or perineum exists. A wound of the groin or trochanteric region need not prevent its use. No other splint or no modification of Thomas's splint has been so successful in bringing these patients in good condition to the casualty clearing stations. Patients with compound fracture of the femur bear handling particularly badly. Liston's long splint has been much favored by some. Only very rarely indeed do men treated in this splint arrive without severe shock. One need not detail the reasons. During a recent severe battle the mortality of cases of fractures of the femur at casualty clearing stations was reduced by at least twenty five per cent. even though the comparison was made with the results obtained during previous "peace" times. During this battle period practically every case was sent down in Thomas's splints, whereas in the peace period Liston's and other splints were used as well. The death rate from gunshot fracture of the thigh was at one time of the war about seventy or eighty per cent. and probably over forty per cent. occurred at casualty clearing stations. The death rate at casualty clearing stations during this battle was 15.6 per cent. in 1,009 cases. Before this these patients used to arrive in such a shocked condition that they could not be touched for hours. Previous to the battle the method of



A.



B.

FIG. 11.—Sergeant Major Tapson's spring clip (A) from which extension is made (B).

application of the splint was widely demonstrated, with the result that only five per cent. of the cases admitted were unfit to be operated on immediately after admission. This was owing chiefly to the presence of severe wounds elsewhere, and to the fact that, the patients having been lying out, the wounds were already in a hopeless state of sepsis.

The fact that such patients bear handling extremely badly has led to the general adoption of the plan of putting on the Thomas's splint without removing either trousers or boots. Great credit is due to Captain K. M. Walker for having thought of this method. The application of the splint will be gathered from a study of the accompanying drawing and photographs (Figs. 7, 8, 9). The trousers opposite the wound are first cut open freely; the splint should be applied and the extension made with a strong calico bandage or puttee before the wound is attended to; the limb is supported behind by the hand of an orderly; the wound is dressed and the supporting posterior splint, well padded so as to flex the knee slightly, is then slung to the side bars of the Thomas. An anterior short thigh splint prevents flexion of the upper fragment and gives greater security. The footpiece is finally fixed in position and prevents wobbling of the foot better than anything else. If the boot has been removed the foot should be well padded before the footpiece is applied. If the boot has to be removed on account of wounds of the foot, extension may have to be made by ordinary adhesive plaster strips applied to the leg above the wounds, but when possible, all things considered, a clove hitch around the padded ankle, knot on the outer side, is most suitable.

When extension is made clot may be dislodged from the lumen of the main artery. As already remarked, death has occurred from this cause in patients previously exsanguine. Therefore, in order to get at the wound easily, no encircling bandage should be put around the dressings before extension is made, and the necessity for immediate digital

compression of the femoral should be borne in mind. The extension should be examined at every stopping place and adjusted if necessary. A posterior long supporting splint is better than interrupted slings. Prevention of wobbling of the foot by the footpiece is important. The splint should be slung by two pieces of bandage from the suspension bar. If a suspension bar is not available these bandages may be tied to the traverse of the upper bunk in the ambulance car. The patient's pelvis may be steadied by a broad bandage encircling both pelvis and stretcher, but the splint should be allowed to swing freely, otherwise jarring occurs. Unless there is a distinct indication for changing the dressings of these patients during transport they should not be interfered with except to control extension. Patients who arrive at casualty clearing stations without these points being attended to are always in worse condtion than those who have been properly looked after.

If the suspension bar and the footpiece are not available at very advanced posts, the projecting end of the Thomas's splint should be supported on, for example, a brick, so as to carry the heel free from the stretcher and the foot fixed by a figure of eight bandage. If a supporting back splint is not available, the leg of the trousers should be cut down in front and pinned firmly over each side bar of the Thomas's splint, as shown in Fig. 10. If a patient is picked up on the field, the following device will be found serviceable. A puttee or strong bandage is passed under the perineum and round the head handle of the stretcher on the side opposite to the injury, pulled and tied firmly. A clove hitch is fixed over the ankle and strong extension is made round the foot handle on the same side as the injury. Two or more splints are fixed on the thigh by two strips of bandage or splint tapes. The foot is kept from rotating by the support of bricks, equipment, etc., or the toe of the boot is connected by bandage to each of the foot handles. The pelvis

should be bandaged to the stretcher. There are many other methods of making extension from the boot. One of the best is that introduced by Sergeant Major Tapson, R. A. M. C., shown in the diagram, Fig. 11. It is made from thick wire such as can be extracted from the broken up bedsteads found in ruined houses. Splint tapes may be used to make extension.

*Fractures of leg bones.*—For those in the upper part of the leg Thomas's splint as applied for fracture of the thigh is the most suitable. For those in the lower part of the leg a long back splint with footpiece plus two lateral straight splints, which should bear both on the footpiece and on the back splint, should be applied.

*Wounds of joints, especially knee joints.*—All penetrating wounds should be splinted. In the case of the knee, if the wounds are not accompanied by fracture a straight gutter splint, reaching from the tuber ischii to the heel, is sufficient. More serious wounds, with fracture, should be put up in a Thomas's outfit.

*Head wounds.*—The scalp around the wound should be well soaked with picric acid solution. In gutter wounds, any gross dirt, projecting bone, or foreign body should be removed and a piece of impregnated gauze placed to keep the wound open. In a puncture wound no attempt should be made to disinfect the track. In no case should the brain be interfered with except to remove any visible loose bone or foreign body which during transport might cause further damage. Direct pressure by dressings over a hole in the skull should be avoided as it may cause cerebral compression to occur. Rather make a bank of folded gauze on each side of, or all round, the wound so that blood or disintegrated brain can readily escape. Head cases should be propped up when possible. If this is not possible a soft pillow should be placed under the head, and

sandbags, pillows, etc., placed at each side to prevent lateral movements during lurches of the car.

*Chest wounds.*—In view of the success which has recently attended radical operations, severe chest cases should be sent to the casualty clearing stations as soon as possible. Although not so urgent as abdominal cases, yet delay imperils the success of the operation. Men with open sucking wounds and severe intrapleural hemorrhage may be so collapsed or distressed that they cannot be sent on at once. The closure of an open sucking wound brings about very rapid relief and should be done immediately. This closure is best done by suture, with local anesthetics if necessary; by corking the wound with gauze plug, which is prevented from slipping by adhesive strapping; or by occluding the opening with a broad piece of strapping. Administration of morphine helps such patients greatly. A considerable risk must be taken in sending on many of these cases. The worse the wound the sooner will the patient die if the chest cannot be closed. If suture of a sucking wound is made, a note should always be sent with the patient stating that an open wound of the pleural cavity was present and that the patient requires immediate attention.

*Abdominal wounds.*—These should be sent on at once to casualty clearing stations unless it is obvious that the patient is dying from shock or hemorrhage. It must be continuously borne in mind that wounds of the chest, especially of the lower posterior parts, and wounds of loins or buttocks are frequently associated with penetration of the abdominal cavity. In cases of doubt always treat as if penetration had occurred.

*Multiple wounds.*—These are apt to be associated with, or to produce, very severe shock. All possible care, therefore, should be taken to prevent or assuage it. The patient should be handled as little as possible. It is often preferable to leave such men absolutely alone for a few hours, simply seeing that they are kept warm. Sedatives may be given if

the patient is in pain. Cardiac stimulants are indicated if the circulation is very feeble.

*Notes on field medical cards.*—In periods of great stress time will be saved in the aggregate by having a special orderly detailed to make notes in the dressing room. The name of the medical officer treating the patient should be put on the card. These notes are essential for satisfactory treatment of the patient in units farther back. The following points are noted: 1, nature and severity of the wounds; 2, presence of shock; 3, dose and time of giving morphine, etc.; 4, amount of antitetanic serum injected. This is given at the advanced dressing station, but should be made certain of at all units further back; 5, a very short description of any operation or special treatment carried out. If foreign bodies or fragments of bone have been removed, this should be stated.

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