

carbolic lotion (Fig. 27). These absolutely prevent the tubes from slipping in. These tubes are always kept in a large vessel containing 1-20 carbolic acid solution, and are thus always ready for use. When a tube is altogether removed from a wound it is not thrown away, but is washed and put into the bottle with the other tubes, and used for another case. These tubes vary in size according to the size of the wound and the amount of discharge expected, and are arranged so as to drain the parts of the wound which form cavities or from which the greatest amount of discharge will come. It is not necessary that their orifices be dependent, though it is of course better that they should be so. It is not essential, however, because the fluid, as it forms, wells out, and, not being putrid, that which lies at the bottom of the drainage-tube does not cause irritation. In cases where the most dependent opening would be near sources of putrefaction, it is well to have the drainage-tube in another part of the wound, even though it be not so dependent.

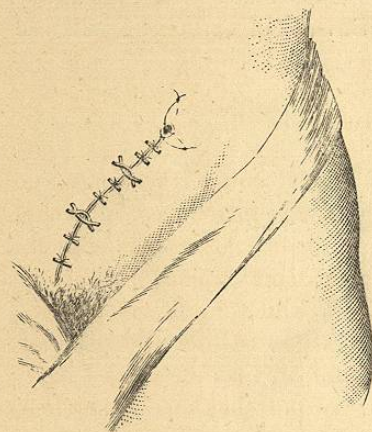


FIG. 28.—INCISION FOR INGUINAL HERNIA, STITCHED, SHOWING THE POSITION OF THE DRAINAGE-TUBE AT THE OUTER ANGLE OF THE WOUND.

Thus in inguinal hernia the tube would no doubt be in the most dependent part if its orifice were close to the pubis, but as that would be much too near sources of putrefaction, such as the vagina and penis, the orifice of the tube ought to be at the outer angle of the wound (see Fig. 28). In a large wound it is well to have more than one tube; and it is better to have two smallish tubes in any case, rather than one large one, because on the day after the operation one of these tubes may be removed altogether; whereas if a large one were pulled out in order to insert a smaller, there would be the greatest difficulty in introducing either. No tube which one wishes to put back again should be removed till the third

day, on account of the difficulty of returning it. By that time, however, it lies in a channel in the blood clot or lymph, and slips back easily. Fig. 29 represents forceps introduced by Mr. Lister, and called 'sinus forceps,' which are of the greatest service in inserting drainage tubes. Generally on the third day half the tube is cut off, and it is reduced in length at subsequent dressings till it becomes no longer necessary. No exact rules can be given for shortening or leaving out the tube. This must simply be a matter of experience, guided by the amount of discharge and the tendency to accumulation or otherwise. Should tension occur, a larger and longer tube ought to be at once introduced.

A point which has always seemed to me of great importance in connection with the use of these tubes, and one which has apparently been overlooked, is the following. A tube is taken

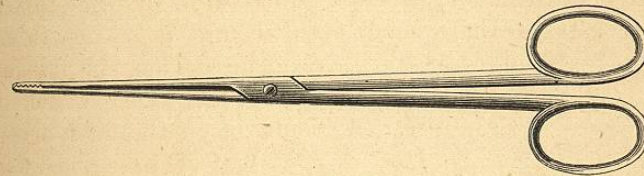


FIG. 29.—SINUS FORCEPS.

out of carbolic lotion at some distance from the spray, is carried through the air, and then directly introduced into the wound. I can hardly believe that when a large tube is taken out of the lotion there would be sufficient vapour of carbolic acid in it to destroy any septic dust which might get into its interior, for a considerable mass of air must take the place of the fluid, and this amount of hospital air may often, as I have found by experiment, contain causes of putrefaction. Of course when passing through the spray this air may be displaced or purified, and also when introduced into the wound a considerable amount of it would be forced out; while at the same time there is a good deal of carbolic acid present, and purification in one way or another would probably occur. And further the purifying power of healthy living tissues, which will be afterwards demonstrated, must be taken into account. But in the case of a cavity, purification in any of these ways may

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not happen, and putrefaction may result. In a case of incision into the knee-joint, which will be afterwards alluded to, in which fermentation and inflammation occurred, this seemed to me the most probable explanation. My suggestion therefore is always to take the tubes out of the lotion *in the spray*, and then the air which enters them will be air previously acted on by the spray.

Drainage by capillarity was introduced by Mr. John Chiene, who was also the first to enunciate the principle of absorbable drains. For this purpose he uses catgut, and generally the

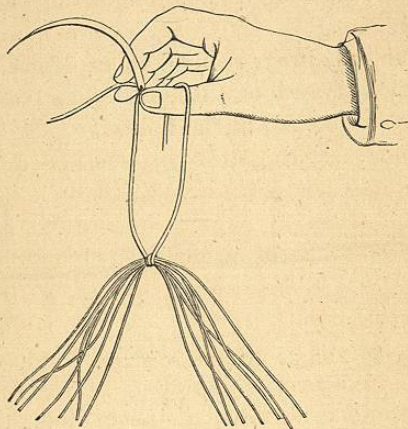


FIG. 30.—CATGUT DRAIN READY FOR INSERTION.

finest threads. A skein of catgut, containing say twenty threads, is tied at its middle by a single thread of the same gut. One end of this thread is passed through a needle (Fig. 30), and by means of this the centre of the skein is stitched to the deepest part of the wound (Fig. 31). The skein is now broken up into bundles of five or six threads each. One bundle comes out at each angle of the incision, and the other bundles at intervals between the stitches (Fig. 32). More than one skein may be required in a large wound. This catgut becomes absorbed, and never requires to be removed. In five or six days the ends which hang out drop off, and little granulating sores are formed which heal in a few days. In this method the serum escapes by capillarity, and by distributing the threads

over various parts of the wound the true principle of drainage is carried out; for, as pointed out by Mr. Chiene, in draining a field one does not have one large drain going from one end of the field to another; on the contrary, the field is traversed by numerous small drains. And so in Chiene's method of draining wounds we have a number of small drains traversing the wound in several directions. In this method there is no trouble about pulling out the drain, and no necessity for changing the dressing simply to remove a tube; the drain disappears of itself. It is well to leave the ends of the catgut outside the wound as long as possible, so as to get a siphon action, and care must be taken not to break up the bunches of catgut outside the wound, for the capillary action occurs in the intervals between the threads when they are closely apposed.

The objections urged against this method are, firstly, that in large wounds it is not sufficient, and that the catgut becomes a pulpy mass, and when in large quantity takes a long time to organise. Not only may it be insufficient at first, but it may become absorbed too soon—before, indeed, a drain of some kind can be dispensed with.

Now these objections rest in great part on the fact that the drain is often improperly employed. If, for instance, it be not stitched to the deepest part of the wound, the catgut may slip and the deeper parts may not be drained; and again, if a large bundle of it be used, coming out at one part of the wound only, it does become a pulpy mass, and takes a long time to organise. But this is not the method recommended by Mr. Chiene, for he says that only five or six threads ought to be brought out at each place. There is, however, no doubt that in some cases it is absorbed too quickly, and this was the real objection to the use of this method when we had only the catgut prepared by the old method, though even with it, if the gut was well prepared and old, the drainage was often very satisfactory. This difficulty will probably be overcome by the use of the chromic catgut recently introduced; the only fear, indeed, will now be that the drain may last too long. Mr. Lister, however, thinks that if only the finest gut be used, according to Mr. Chiene's directions, the probability is that it

will be absorbed with sufficient rapidity. Of course, if necessary, the ends of the drain can be cut off, when it has served its purpose, below the level of the skin, and then, even though the internal part be not all absorbed, the wound can heal completely.

Catgut can only drain fluids such as blood or serum; it cannot drain pus. It is, however, unsuitable in cases of chronic abscess, where we have only a serous discharge, because the catgut is absorbed long before a drain can be dispensed with.

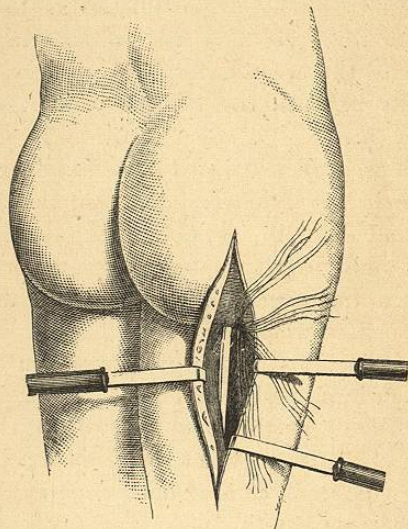


FIG. 31.—OPERATION FOR STRETCHING THE SCIATIC NERVE.

Catgut drain stitched to the deepest part of the wound, beneath the gluteus maximus, and broken up into four separate bunches.

If the wound is very large it is well to introduce tubes as well as catgut drains at first. The tubes may be removed in twenty-four hours.

Instead of catgut, horse-hair has been a good deal used. This is simply laid into the wound in the situation where it seems most required. It is diminished by degrees, threads being taken out at various intervals of time. It has an advantage over catgut in draining joints, for no part of the drain

remains in the interior of the joint, while portions of catgut do. Further, it is not absorbable.

But it has the same disadvantages as the drainage tubes, and it is not readily retained in the deeper parts of the wound. It is preferred by Mr. Lister to the catgut, but there can be no doubt that the catgut, when used strictly according to Mr. Chiene's directions, and of good quality, is a very efficient method of drainage.

It is easy to re-introduce a horse-hair drain if necessary by proceeding in the following manner:—A sufficient quantity

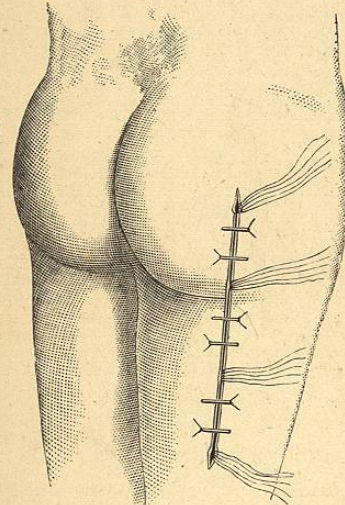


FIG. 32.—THE SAME WOUND STITCHED.

The bunches of catgut coming out at intervals between the stitches. (The wound has been exaggerated, and the threads of catgut separated, in order to show the method more clearly. The threads of catgut ought to lie in close apposition, for it is the intervals between the threads which act as capillary drains.

being taken, the bundle is bent at its middle over a probe, and tied close to the probe by carbolised silk (Fig. 33). In this way, the probe being withdrawn, a blunt compact end is obtained, which may be introduced into the wound with ease.

Of late the principle of absorbable drains has been applied by Dr. Neuber of Kiel¹ in his absorbable drainage tubes.

¹ *Ein Antiseptischer Dauerverband nach gründlicher Blutstillung.* Von Langenbeck's Archiv, Bd. xxiv. Heft. 2.

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These are tubes drilled in long bones, and then decalcified and carbolised. Holes are afterwards cut in the sides, and they are used like ordinary india-rubber tubes. These tubes are said to answer very well, though they are sometimes absorbed too soon, and sometimes last too long. They sometimes get soft and collapse about the third or fourth day, and thus, though not absorbed, become useless as a drain.

Dr. MacEwen¹ has lately somewhat modified Neuber's tubes. He uses chicken-bones, which are already hollow, and decalcifies them. 'The method of preparation is as follows:—The tibiae and femora are scraped and steeped in hydrochloric acid and water (1 to 5) until they are soft. Their articular extremities are then snipped off with a pair of scissors; the endosteum is

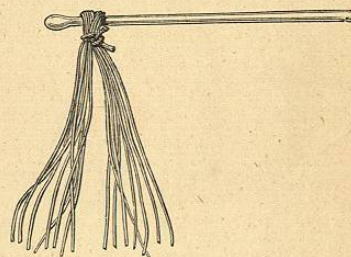


FIG. 33.—METHOD OF PREPARING A HORSE-HAIR DRAIN FOR RE-INTRODUCTION.

raised at one end and pushed through to the other extremity, along with its contents. They are then re-introduced into a fresh solution of the same strength until they are rendered a little more pliable and softer than what is ultimately required (as they afterwards harden a little by steeping in the carbolised solution). When thus prepared they are placed in a solution of carbolic acid in glycerine 1-10. They may be used at the end of a fortnight from the time of introduction into the glycerine solution. Holes may be drilled in them with a punch, or clipped out with scissors.' These tubes are threaded with horse-hair before being introduced into the tissues. This hair helps to maintain the calibre of the tube during the first few days, and also itself acts by capillarity.

¹ *British Medical Journal*, Feb. 5, 1881.

The average duration of MacEwen's tubes in the tissues was something over eight days. If, however, a tube is likely to be required for a longer time, it can be obtained by steeping the decalcified tubes in a chromicised instead of a carbolised solution. These resist the action of the tissues for two or three weeks.

The accurate stitching of the edges of the wound is another feature in aseptic surgery. In operating aseptically the same care need not be taken to remove as little skin as possible as is necessary in wounds treated by other methods where swelling and inflammation of the edges are expected. One may take away a wide sweep of skin, such as would seem to render hopeless any attempt to bring the edges of the wound into apposition; and yet if the edges can only be apposed, and if

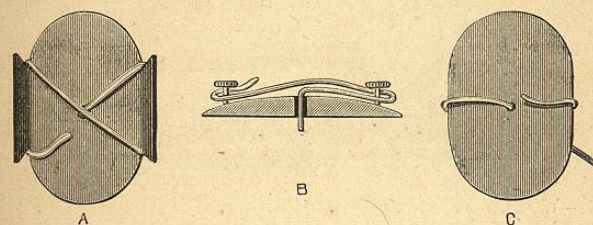


FIG. 34.—LEAD BUTTONS FOR DEEP STITCHES.

A, The present form, described in the text. B, Form of button devised by Dr. Ogilvie Will (seen in section). C, The old form, where the wire was fastened by passing it beneath the button.

the wound remains aseptic, union by first intention may be expected along the whole line.

Button stitches are employed to relax the edges of the wound, and thus to leave the cutaneous margins free from the irritation which must occur if they are tightly drawn together. These consist of flat pieces of lead cut of an oval form and of various sizes, perforated in the centre by a hole through which silver wire is passed, and provided with two lateral wings round which the wire is twisted (Fig. 34). (There are various forms of button suture, but all act on the same principle.) These are applied some distance on each side of the edge of the wound, and connected by strong silver wire drawn tight enough to permit the edges of the wound to come pretty easily together. The number used varies according to the amount of tension.

In order to bring the edges of the wound into actual contact, two sets of stitches are employed: silver wire stitches, which take a good hold of the tissues and are placed at regular intervals, termed stitches of relaxation; and in the intervals between these, in order to have the cutaneous margins accurately applied to each other, numerous stitches of coaptation, consisting of carbolised silk, horse-hair, or catgut are inserted (Fig. 35). The speedy healing which occurs when the edges of the wound are accurately brought in contact, while they are at the same time, by the button stitches and the stitches of relaxation,

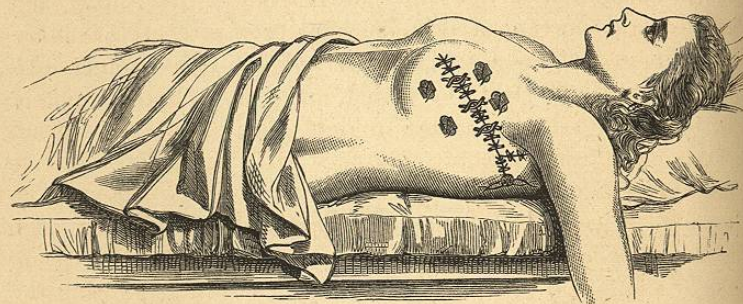


FIG. 35.—WOUND AFTER REMOVAL OF MAMMA AND AXILLARY GLANDS, STITCHED.

To show the three kinds of stitches. The button stitches will be at once recognised; the thick stitches, of which three are represented, are the stitches of relaxation; and the remainder are the stitches of coaptation.

freed from any tension, rewards the surgeon for the time spent in inserting a large number of these stitches of coaptation.

In taking out these stitches it is best to follow a reverse order to that of insertion. The first to be removed are the stitches of coaptation, while the stitches of relaxation are probably cut on the same day. Do not be in a hurry to remove the stitches where there was much tension in bringing the edges of the wound together. A week or ten days is time enough.

Should the wound gape, strapping may be employed, even under an antiseptic dressing. To render the strapping aseptic, it is immersed in warm carbolic lotion (one part of 1-20 and an equal part of boiling water) before being applied. This both

renders it aseptic and also takes the place of the hot-water can for heating the strapping.

Having proceeded thus far in the aseptic operation—having tied the vessels, arranged the drainage, and brought the edges of the skin well together—we must now apply a dressing which shall prevent the occurrence of putrefaction till the case is again seen.

In applying a dressing we must in the first place be careful to make it as little irritating as possible to the young epithelium along the line of incision. The dressing employed is the carbolic gauze; and, to prevent the irritation of the healing edge of the wound by the carbolic acid, a piece of protective is interposed between the gauze and the wound. This protective is cut a little larger than the wound, and it is well to cover the buttons with a little bit also, in order to prevent the threads of the gauze from becoming entangled in them. This protective need not extend over the orifice of the drainage tube, as its essential object is to protect the healing part from the irritation of the carbolic acid. The protective is also of use in preventing the dressing from sticking to the wound, and in preventing the formation of scabs, and the consequent possible retention of the discharge.

An error which is frequently made is to put on too large a piece of protective. There is nothing antiseptic in its substance, and it protects the discharge beneath it from the action of the carbolic acid. Therefore if at any part it projects beyond or comes close to the edge of the dressing, it allows the causes of putrefaction to spread inwards beneath it, and prevents the carbolic acid from acting on this putrefying discharge. It is therefore a very good rule, having covered the wound with sufficient protective, to look on this protective as a wound, and to be as careful in having the gauze dressing overlap it in all directions as if it itself were the wounded surface. Where there is very little space for overlapping, as in inguinal hernia, no protective ought to be applied. It is better to have somewhat slower healing than to have putrefaction spread into the wound. As mentioned before, this protective is dipped in carbolic lotion 1-40 before being applied.

Outside the protective a piece of gauze wet in the carbolic

lotion 1-40 is applied so as to overlap the protective in all directions. The reason for this is that dry gauze is apt to receive dust on its surface before being used, while at the ordinary temperature of the atmosphere but little carbolic acid is given off from the gauze, certainly not enough to destroy immediately the activity of the septic particles in the dust. But if the piece of gauze applied next to the protective be moistened in the 1-40 solution, this dust is at once deprived of septic energy, and we apply over the wound a layer of pure and powerfully antiseptic material.

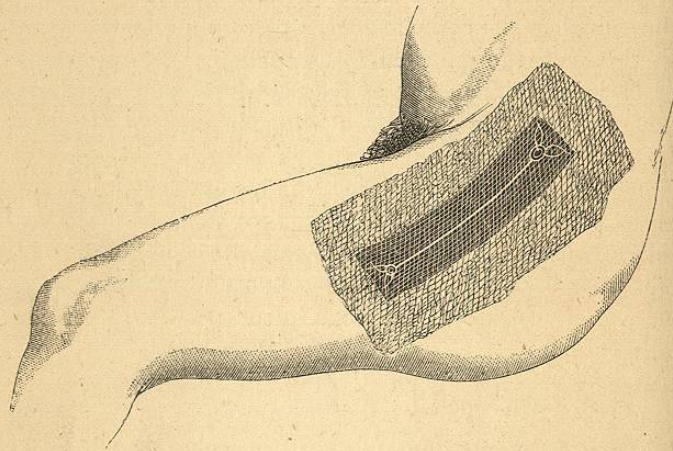


FIG. 36.—EXCISION OF THE HIP-JOINT.

Wound stitched; protective and deep dressing applied.

The piece of wet gauze and the protective go by the name of the deep dressing. This deep dressing may in some cases, and more especially where catgut stitches and catgut drains are used, be left for several days undisturbed. In this way the wound is not irritated by the application of carbolic acid to it every time the dressing is changed. If the deep dressing be thus left on, it must be remembered that the deep piece of gauze loses all its carbolic acid very soon, and that therefore it must be treated as a wound—*i.e.*, in renewing the dressing this deep part must be overlapped in all directions by a piece of wet gauze, and that again by a dressing of suitable size.

In some cases it may be desirable to fix down the deep dressing with a piece of gauze bandage. If it be intended to leave on this deep dressing for some time it is well, before applying it, to rub the neighbourhood of the wound with the salicylic cream mentioned before. It sometimes happens that when a dressing is left on for many days together, the discharge becomes somewhat irritating, and the skin around the wound becomes excoriated. This is generally entirely prevented by the use of salicylic cream.

Having arranged the deep dressing in a suitable manner, any hollows which exist in the neighbourhood of the wound are filled up with carbolic gauze, and special masses of this material are placed where the greatest amount of discharge is expected. Outside this a large gauze dressing, made as before described, is applied. The size of this dressing varies according to the amount of discharge expected, but in all cases it must extend well beyond the deep dressing in all directions. Some special examples will be mentioned presently.

This dressing is fixed on with a suitable bandage. The gauze bandage is preferable to an ordinary bandage under certain circumstances. It is especially convenient in bandaging a stump next the skin to prevent retraction of the flaps, and also for fixing down the deep dressing. It also increases the amount of antiseptic material outside the macintosh if there happens to be a hole in it. But for ordinary use in fixing on dressings very light and cheap bandages may be made from the ordinary thin muslin which is used as a guard. They do not stick to the skin as the gauze bandage is apt to do.

The dressing is pinned round its edge to the bandage. Care must be taken not to put pins through the macintosh at any part except at its edge. Pinholes through the centre of the macintosh simply defeat its object by permitting the discharge to come directly through the dressing. The object of the macintosh is to make the discharge travel through a large extent of the gauze, and thus the same result is obtained as if a mass of gauze were applied over the wound, of the same thickness as the distance from the centre of the macintosh to its edge. If therefore there be a pinhole near the centre of the macintosh, the object of the latter is seriously interfered