

"EFFICIENCY ENGINEERING" IN PELVIC SURGERY: ONE AND TWO-SUTURE OPERATIONS¹

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THIS paper is a plea for systematic study of our efficiency. If other handicraftsmen are employing experts to teach them how to eliminate waste motions and how to standardize technique, it behooves us to further such investigations in operating room, in ward, and in office. For beyond any other craft the surgeon's work demands the new "scientific management." It is not only that on occasions time is a matter of life and death; it is not only that speed is a matter of lessened shock and quicker recovery; it is mainly that habits of hand work controlled in the ways of the best motions by the automatic lower centers bring about freedom of the higher brain for those weighty decisions, that concentration on the rest of the problem, and that watchfulness of the patient which are called for in nearly every operation. No item is too small to think of, no training too laborious. All the way from printed directions for office patients up to dissection in the most radical cancer operations there is

hardly a detail unworthy of consideration. The present question is how to attack the problem. It must first be defined, its parts allotted, the tentative results published for test by a number of operators, and a clearing house devised for combining conclusions. Meanwhile let us glance at some aspects of the matter.

Hospital Standardization. Toward the standardization of medical schools, here and abroad, a long first step was taken by disinterested outside study.² Whether we agree or disagree with the premises on which the estimates were made it is evident that the scope of the plan and the publicity cannot but be beneficial. The next great step is inspection and standardization of hospitals. This also must be undertaken in a large-minded way. In the October number of *The Modern Hospital* the editor, Dr. J. A. Hornsby, author of the recent book of the same name,³ takes the ground that the

¹ Carnegie Foundation Reports on Medical Education, Bulletin 4, 1910.

² *The Modern Hospital*, Saunders, Phila., 1912.

³ Read before the Chicago Gynecological Society, November 15, 1913. (See discussion, p. 649.)

physician is too close to the problems to solve them properly, and that he is often handicapped by working for a single department of his science. He argues, therefore, that one of the great foundations should make the investigation.

Does part of this investigation and standardization belong to our profession? I should say that the general surgeon or the special surgeon could best aid this work by analyzing a number of every-day procedures in the operating room or the ward, leaving questions of administration, of nursing organization, of feeding, of supplies, and the like to be studied by the efficiency engineer.¹ The time has come to urge that the national societies combine to undertake specific work in this direction.

In hospital management, until proper plans have been worked out, perhaps the most effective control in professional matters is by the clean-cut responsibility of one man committees. For example, the routine of the operating room is to be figured out, reduced to writing, and carried through by one of the surgeons. A careful consensus of opinion on the part of the various operators is scheduled and an average or standard technique agreed upon. Thus, let us say, two lengths of ligature are specified as regular, and three sizes of catgut, and nine different needles, which must always be ready. A routine form of skin preparation is to be employed unless a different one is specifically ordered. These are only examples. The individual equation and initiation are not handicapped, but departures from standard are recognized as such and radical alterations are matters of conference or arrangement. Thus what was haphazard becomes systematized, well understood, economical of time and material. Histories are placed in the hands of one man, who enforces a standard nomenclature of diseases and operations and an irreducible minimum of entries; the ward routine is in charge of another, who sees that not tradition but typewritten regulations rule. The dispensary, in professional matters, is administered by a third. Subcommittees or sub-

stitutes are allowed, but authority and responsibility are sharply defined.² Such men might be called the functional foremen of the health factory, bound over either to make good or to make way, being an effective executive committee, presided over by the man who appoints them, the president of the staff, and reporting to the staff, which is annually named by the trustees.

Clinical Travel.—Too much stress cannot be laid on the astounding stimulus systematic visiting provides for the overhauling and practical review of one's methods and resources. Not sporadic and occasional visiting, but that done at regular intervals with every second or third year a longer trip affording opportunity for making wide generalizations and time in which to do steady thinking. Any small group of men may, within six years, in reasonable vacations, inspect all the best clinics in their own line in this country and in Europe.³

In their travels selection may be made of those clinics whose efficiency will best repay an analysis looking toward the standardization of others. The example that springs first to mind is the Rochester clinic. The definition of authority, responsibility, and system in certain institutions; the remarkable teamwork in individual operating rooms; the laboratory equipment of some surgical departments, the follow-up methods of others; the impressive teaching devices of one man, the student's participation under another; the high average technique of a whole city—the best can be selected for study and emulation.

Illumination.—As an instance of the need of scientific studies let us take the subject of the illumination of the field of operation when that field is in a cavity like the vaginal canal or the laparotomy well. Hitherto all stress has been laid upon the attempt to get light as brilliant as possible. One way is by large skylights and windows, another by electric bulbs with reflectors, a third by the beam from an arc light outside the room reflected from one or more mirrors, as in the larger German clinics. As far as I know no study

¹ Dickinson. A Visit to Brooklyn Hospital. Long Island M. J., 1910, November.

² Dickinson. Clinical Travel, Brit. M. J., 1913, Oct. 18.

³ Reports by the Committee on Hospital Efficiency to the Philadelphia County Medical Society, June 17, and November 26, 1913.

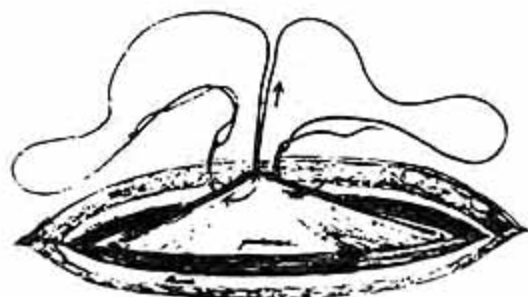


Fig. 1.



Fig. 2.



Fig. 3.

Fig. 1. Simplified method of closure of the abdominal wound, eliminating needle holder, several clamps, thumb forceps, and retractors. The peritoneum is picked up by a middle tie stitch; operator and assistant whip over toward the angles at the same time.

Fig. 2. The peritoneum is closed and the same stitch starts to close the muscle. It may be tied at each angle if desired.

Fig. 3. Longer sweeps approximate the muscle and the stitch is tied in the center of the wound.



Fig. 4.



Fig. 5.



Fig. 6.

Fig. 4. The same strand goes on in two directions to close the fascia, beginning at the center.

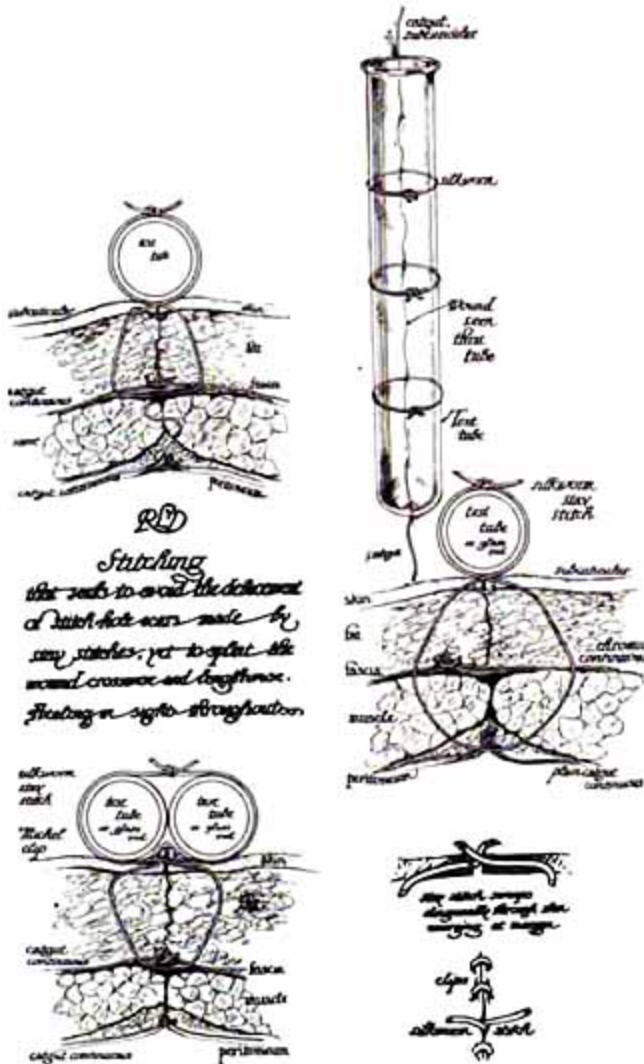
Fig. 5. The fascial layer suture ends with a tie at each angle; this usually completes the layer suturing.

Fig. 6. Longitudinal section of wound. If desired, the same stitch may be used as a subcuticular, tying in the center of the wound with a knot that hides itself beneath the skin.

to find instruments and thread needles, with a beam of light thrown into the wound from more than one direction and the covers about the wound of a color of the same actinic value as the pink and red surfaces within. Black sheets look dingy. Red rubber (fortified with fabric) is an example of a color value of about the required intensity.

For night work it was long accepted that the ideal conditions for reading existed when, in a dusky room, a bright light was centered on the page, as by a shaded lamp, and in an operating room when a group of lights was equipped with reflectors to focus the light rays and with a glass screen to stop the heat rays. The eye men, however, have taught us that under these circumstances the pupil adjusts itself to the general darkness of the room and opens wide. Hence the spot of brightness hits the retina a blow. If this be true, then, in night operating, with a brightly lighted field, the rest of the room should show diffused lighting, and the environs of the wound a color value not far from that of the area on which work is being done. But this whole subject, as well as cross lights, sky-

has been made of the results in their bearing on the surgeon's retina. One's first idea would be that the brighter and more abundant the light the better. But this is not true. Indeed the paradox is truer that the more brilliant the general illumination the less will the eye see into deep caverns. The pupil contracts from the strong illumination of the entire room and particularly from the glare on white sheets and towels encircling the field. The eye is handicapped. With the beam thrown directly into the cavity the conditions are better but not yet right so long as the surroundings are all white. The most desirable arrangement would seem to be a room with ample light to enable the nurses



Figs. 7, 8, 9. Stay stitches that leave no stitch-hole scar, the test tube being used as a bolster and a slanting grip of the skin edges taken.

light, summer glare, and so on, calls for the kind of study for which we plead.¹

Abdominal Incision.—Suppose we select another every-day problem for time study and motion study, with the proviso that we all deprecate mere operating against the

¹ Grober, Das Deutsche Krankenhaus, Fischer, Jena, 1911, pp. 160, 172, 315, 536.



Fig. 10. Needle in which thread jams in a pointed eye so that it cannot slip out during operation (McRae).

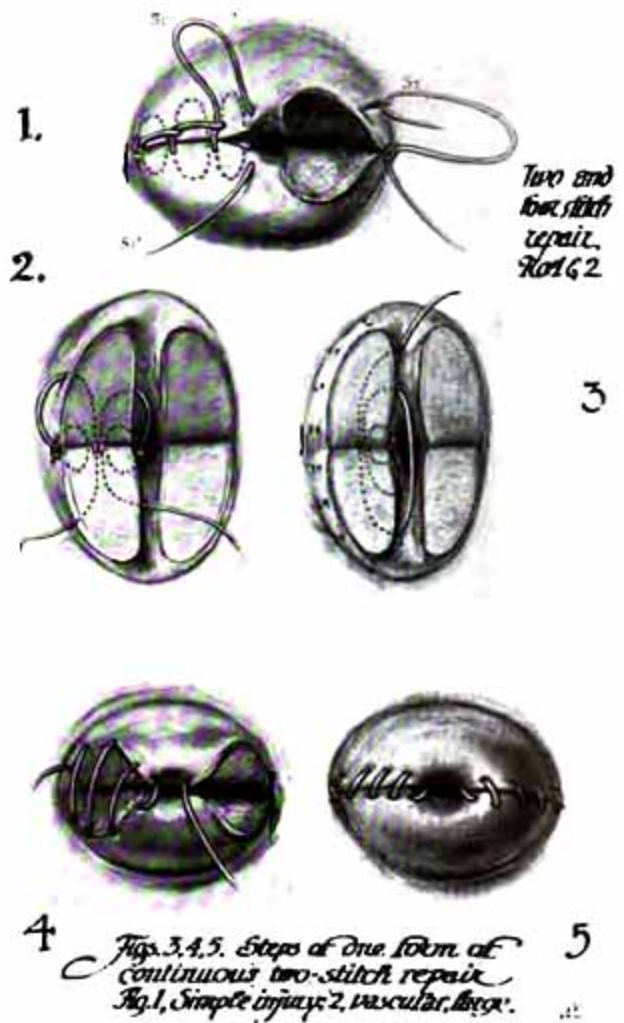


Fig. 11. Various forms of continuous suture as applied to cervix repair. These may be submucous in location.

clock. In closing the abdominal incision, what is the swiftest simplification compatible with good workmanship? Restriction of the number of assistants and tools and motions with selection of the best of these in the best sequence—that is the matter for study. The irreducible number of tools would be a needle and a suture. Can we dispense with needle holder, retractors, the several clamps used to pick up peritoneum and fascia, and thumb forceps? Can some knots and sutures be eliminated? Can two men work simultaneously on the larger incisions?

Let us, then, on the simplest possible scale undertake various trials. Let us test this, for instance. A No. 1 plain or No. 0 chronic



8.

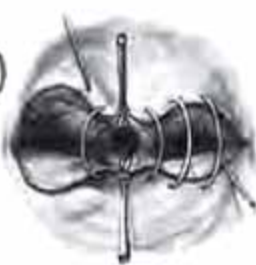


Fig. 12. Continuous suture in amputation of the cervix by a suture from each side.

Fig. 13. Amputation of the cervix by two continuous sutures, the start being made in the center line.

catgut (20 to 28 inches long, according to the length of the incision) is armed at each end with a needle large enough to be manipulated without a needle holder and sharp enough to cut the skin but not to slice blood vessels (e. g., the Mayo-pointed). Two fingers pick up the peritoneum at the middle of the incision, and the suture is passed first through one side and then through the opposite peritoneal edge. The strand is tied midway of its length. After tying, traction lifts the peritoneum out of the wound in tent shape, exposing the upper and lower ends of the incision in this membrane (Fig. 1). The operator, in a continuous whip-over, closes the gap in the direction of the pubes, while at the same time his assistant, in all wounds but small ones, does the same in the direction of the navel. Having closed the peritoneum (Fig. 2), the same strand now doubles back, in longer sweeps, to approximate the muscle edges (Fig. 3), the two ends meeting in the middle of the wound, to tie there. Next (if thought desirable) the same stitch may whip the fascial edges together (Fig. 4), tying at the upper and lower ends of the fascial incision (Fig. 5). Indeed one could

carry the scheme still further and use the same stitch for the fat layer or for a subcuticular, if one elected to indulge his fancy to the limit (Fig. 6). Naturally if plain catgut is used, silkworm stay sutures should supplement the support of the fascia. If one prefers plain catgut for the two lower layers and chromic for the fascia, the center-started stitch saves time here also, with incisions five inches or over. If stay sutures are employed, these may be so placed as to leave no stitch hole scar by crossing them at their exit from the skin margins of the wound and tying them over a bolster, which may be an ordinary test tube laid along the wound (Figs. 7 and 8).

The above are suggestions for trial. Many data there are to be worked out and individuals will give very different answers. The Michel clips, for instance, are commonly used in Germany for closure of the skin because of the speed of the procedure, and a long straight cutting needle, like the Keith, facilitates the placing of the subcuticular suture. The end results as to suppuration, broad and tender and unsightly scars and



Fig. 14

Fig. 14. Hysterotomy of both lips. Direction in which continuous sutures should be placed.

Fig. 15. Perineal repair by chromic gut. Frequent pussy appearance of stitch-holes as stitches drop out or are removed.



Fig. 15

hernia—all these are matters for such study as we are here advocating.

In this connection one might propound yet another problem. What is the best method of shielding the abdominal incision from friction, contusion, and infection? Concerning this I have long taken notes and have found precautions generally ignored or abandoned. I believe that no adequate solution has been worked out. Perhaps my shield retractor of rubber fabric with two springs may prove to be such in suitable cases (Fig. 21).

As a single example of the standardization of tools, a study such as we urge would make prominent a needle, a device twenty years in use, which seems to have escaped the notice of most surgeons, possibly because it was never published. A tapering eye jams the suture and prevents that not infrequent minor annoyance and delay, the slipping of the thread from the needle. When well made it does not cut the suture. It would seem that this MacRae eye should become standard, perhaps the standard (Fig. 10).

One more example, this time in training of right habits in handling instruments. Which is least fatiguing? The great German operators keep the gaze fixed on the field, reaching out a hand and calling for the next instrument. Thus the eye does not have to find an instrument and then re-focus on the exact

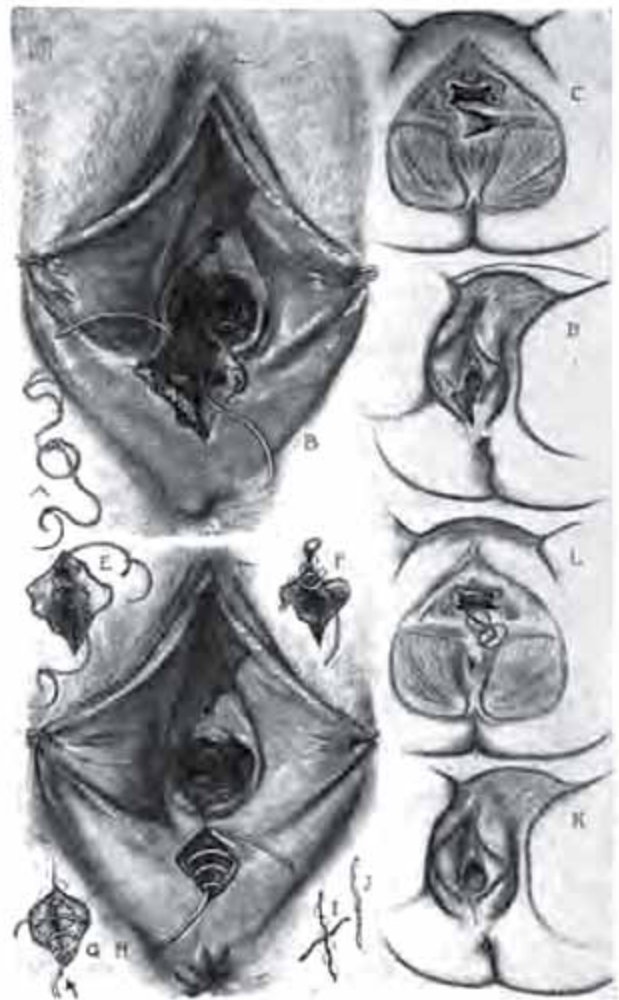


Fig. 16. Primary perineorrhaphy by layer suture, single strand, subcuticular. A anchorage in deepest portion of wound; particularly effective in irregular forms of tear. Result is accurate coaptation (L) almost invisible line of union (K).

point selected for seizure or suture. Again, Dr. F. F. Simpson does not have to look away from his work because each instrument, of those repeatedly used, lies in its own place, and there his hand finds it and there his hand replaces it. The commonalty among us sheds an instrument somewhat haphazard and has not only to look, but to search and select among a group, in recovering it. The new analysis studies all these ways. It might even consider whether a hand signal for an ordinary instrument might not save that delay or that mental annoyance of the moment when, intent on a grave issue, one must withdraw one's mind to form and voice



Fig. 17. Secondary perineorrhaphy by continuous catgut layer and subcuticular. The test of the rectocele (1, 2, 3,) and the guide to the levator (4) being made by stick sponge in the rectum. 11 and 12 show three and four layer method respectively.

the word "clamp" or "scissors." If Dr. Cochem is trying with his trained crew to develop silent operations he might go further and develop what might be aptly termed "pantomime operating." However this may be, when we train golfers, boxers, runners, to standard form and secure 100 per cent efficiency, why not laparotomists?

Repair or Amputation of the Cervix by Continuous Suture.—The usual cervix operation presents a tangle of multiple ties, say four on each side. Each stitch is taken, clamped, laid aside, until all are in place. Then they are unraveled from the bunch, right and left, and tied one by one, each being again laid aside after tying. Lastly scissors are taken to the whole group. It is found that the same result may be attained by two continuous sutures, with four knots instead



Fig. 18. The gauge of the amount of denudation. a. Kocher clamps seize remains of hymen and draw them over two fingers. b. Another grip, with another pair up lateral vaginal walls makes test further in. Stick sponge in rectum facilitates suture of levator.

of six, eight, or ten. Any one of three or four adaptations of the two-stitch method are available. A relatively thin cervix may be treated with a buttonhole suture with its crossings on the vaginal surface of the cervix (Fig. 11, "1"), using one stitch for each side of a bilateral laceration. When the cervix is somewhat voluminous and the tear long, Pomeroy uses two layers. The first turn and tie of the stitch is placed high in the cervical canal laterally, and then this lateral wall of the cervical canal is built down to the external os. From this point the same suture may be



Fig. 19. Primary perineorrhaphy with identification of torn levator and continuous suture of the injury by drawing the retracted muscle from the gully alongside the rectum forward toward the pubic arch.

continued outward under the vaginal surface of the cervix to the cervicovaginal junction (Fig. 11, "2 to 5"). As a rule, however, both sides of the canal are built before the external portion is added.

In amputation of the cervix the sewing may be begun at the outer angle and run inward (Fig. 12). The best way, however, is to start the stitching by a center sweep, with one end for the posterior and one for the anterior lip (Fig. 12, "8"). Each end serves as tractor and as a guide to the median line. The end with the needle is then run as a continuous suture, the rear stitch toward one side, the front stitch toward the opposite side (Fig. 13).

In those instances when pelvic floor repair

is postponed to some time between the second and tenth day post-partum the uterine injuries should be mended at the same time. Continuous suture best effects this. A simple buttonhole stitch is easiest. If with two layers, one starts at the inner end within the cervical canal, grasps almost all the thickness of the cervix, and thus works down to the external os. Thence a submucous stitch, more or less exact, runs along the vaginal aspect of the cervix if necessary (13A). Pomeroy begins on the vaginal surface of the cervix at the rear in double hysterotomies, by running or buttonhole suture; next, the canal side; then with the second stitch, the opposite canal side; last, the remaining anterior vaginal aspect of the cervical lip (Fig. 14). In other words, the far side is done before the near side.

As skill is attained in all these procedures the outer layer is hidden so that no stitch and no knot is in view, but only a line of coated incision.

Perineorrhaphy.—For saving time and elaboration in perineal repair the one-strand, two-knot continuous suture has been found to be the simplest device. In most operations, whether primary or secondary, the center of a long suture may sweep and tie in the deepest part of the wound (Fig. 16 A, B), then the two ends whip over, one upward to close the vaginal gap (Fig. 16 E), and unite the mucous membrane over and over, or by a submucous stitch (Fig. 16 F), the other downward toward the anus (Fig. 16 H), finishing as a subcuticular, to tie to the first part (Figs. 16 I and K and 17 Fig. 17, "9"). We are ready to declare that upon buried catgut of small size entire reliance may be placed for pelvic floor repair after labor. It is even more satisfactory than in secondary operation. In our 58 fresh injuries of various degrees primary union resulted in all but one. We used either interrupted stitches closed over by running intercutaneous lacing, or tier suture with several strands, the last being subsurface; or else, as I prefer, a single strand run as continuous tier suturing, with two ends coming together, one submucous, the other subcuticular, the whole secured by one deep knot and one hidden surface knot. In any of these ways the

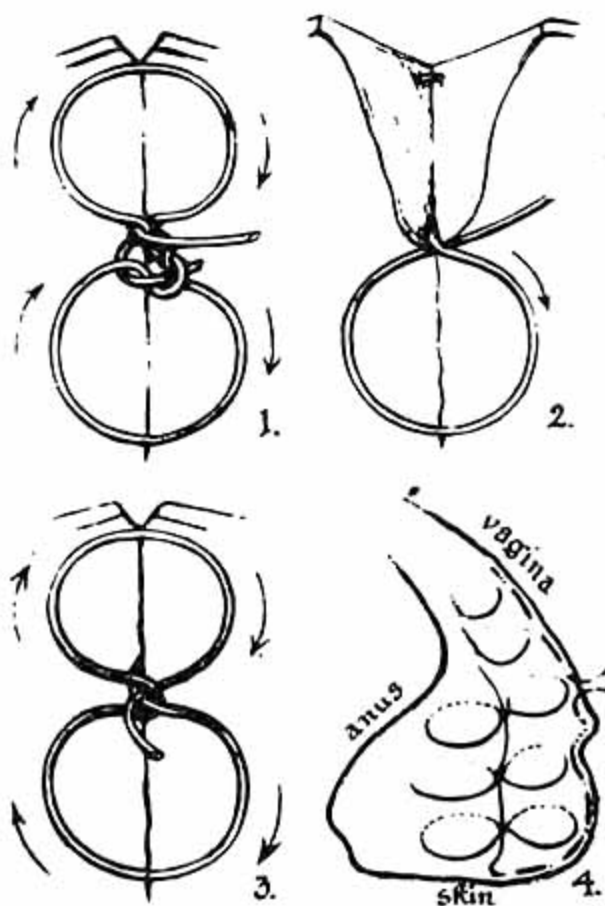


Fig. 20. Three tier suture, by the employment of the figure 8, which is continuous and middle-locking.

wound is practically invisible from the first. Levator laceration found immediately after labor particularly demands tier suture, and anterior fascial gaps are thus best united.¹

In late perineorrhaphy, as now customarily done, where the levator muscle and fascia are drawn inward from the lateral sulci to be fastened side by side in front of the rectum (Noble) the single strand stitch works well. A convenient beginning may be made by placing the first sweep and tie at a point about two-thirds of the length of the suture and at the middle of the lateral bands that are to make the reinforced septum (Fig. 18). Traction on this stitch pulls down within reach the spreading V of the bands higher up so that a sweep may be carried beyond to draw these together (Fig. 17, "5"). This portion of

¹ Dickinson, Buried and Subcuticular Catgut in Primary Perineorrhaphies. N. Y. M. J., 1914.



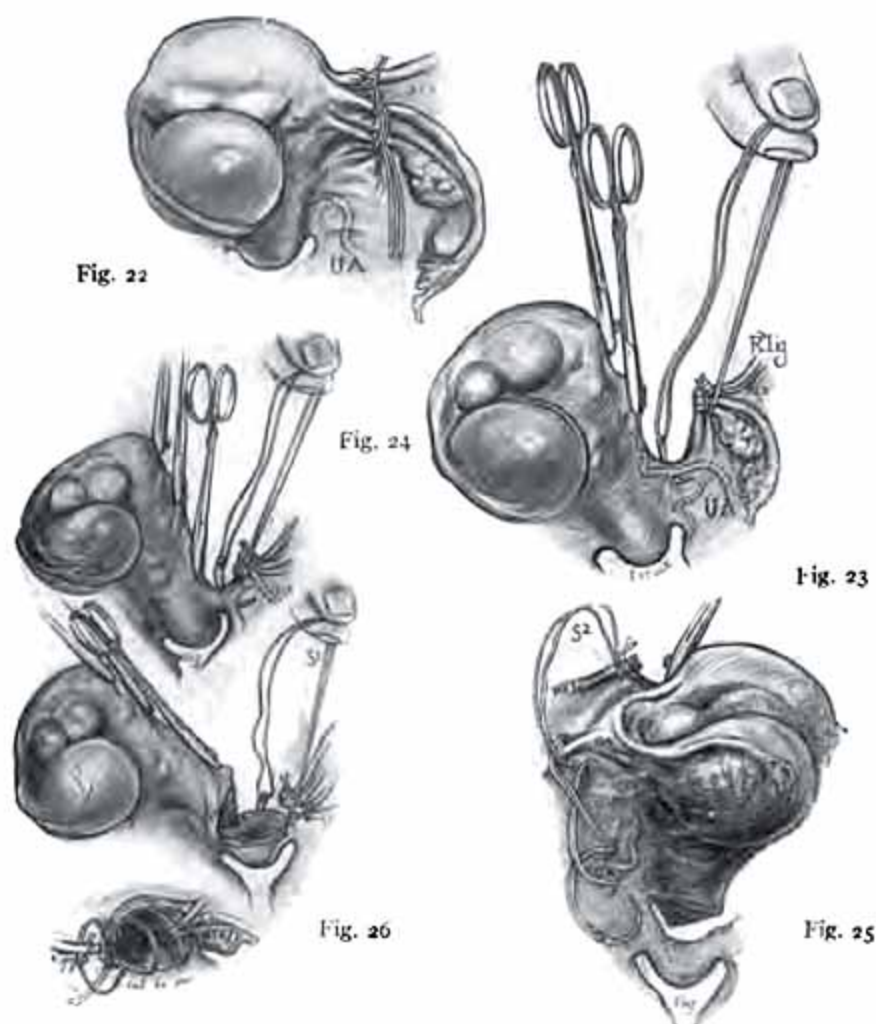
Fig. 21. Shield retractor guarding cut surfaces in abdominal wound.

the suture is thereafter of service to gather the rectal wall and to close the upper end of a Hegar triangle and eventually becomes a mucous membrane stitch or submucous lacing (Fig. 17, "6 x 9"). The end then hangs loose to wait for the completion of the operation, when it ties to the subcuticular coming back from the anal region (Fig. 17, "9").

Let us now return to the knot in the levator (Fig. 17, "7"). To draw together these bands three stitches are often desirable. Two have been placed. The third is now swept about the edges, and best from left to right (Fig. 20, "1"), in order to make the next stitch effective. It then takes any available order. To close the transversus and sphincter vaginae muscles and then the superficial fascia either two (Fig. 20, "4") or three more layers (Fig. 17, "11 and 12") are employed. The aim is to have brought together everything but the skin on arrival at that end of the wound nearest the anus, so that the intercuneate work may proceed toward the hymen and meet the first end there. If there be tension a stay stitch or two may be used.

Such one-stitch repair is a matter of practice. On small injuries it is easy. On the larger it works well in properly selected cases.

In levator lacerations, primary and second-



Figs. 22-26. Steps in the two stitch abdominal hysterectomy. Each loop is drawn taut before proceeding, and kept taut, serving also as a tractor. Into the deeply coned cervix — or vaginal edges — the round ligaments are made fast.

ary, the torn end of the pubo-coccygeus drops backward alongside of the rectal wall as, in a more superficial plane, the sphincter withdraws into a pocket. For anatomical replacement and the drawing forward of the hidden end toward the ramus the continuous suture is found to work better than the interrupted. (Fig. 19.)

Hysterectomy.—The elimination of waste motions in removal of the uterus led to combinations of ligature, suture, and tractor in one, intra-abdominal work I owe to Dr. F. F. Simpson, and the vaginal procedure is my application to the operation of Dr. J. Riddle Goffe. These methods are for the expert, and

even he may, perhaps, at the first trial, combine the ligature with this suture.¹

In simple cases two sutures suffice. I sometimes use more. It is spoken of as a two-suture method because the work usually can be done thus. There has been no slipping, no hæmorrhage, no death, in a series of forty-two cases.

Abdominal Hysterectomy.—The first bite of the suture is usually that which circles the round ligament (Fig. 21). The second stops bleeding from the ovarian artery (Fig. 22). In each case care is taken to bite into and

¹ Dickinson, *Hysterectomy by Two Suture-Ligatures*. J. Obst. & Gynec. Brit. Emp., Sept., 1913. Tr. Internat. Cong., Lond., 1913.

lock into tissue so that the ligature does not slip off a bared vessel. In every case and with every bite the loop must be snugly nestled home without slack or jump or stretch of gut between the bites, except as noted hereafter. Reflux being checked by a clamp on the uterine side, the upper vessels are cut away (Fig. 23). The thin part of the broad ligament is scrutinized. If it exhibits a bunch of varicose veins, sweep number three should encompass them (Fig. 27). We now cut away down toward the uterine, shoving back the bladder in front and peritoneum behind to bare or nearly bare the artery. The next sweep circles it (Fig. 23) and locks home (Figs. 24 and 28). The vessel is cut. The last sweep of the stitch as a ligature circles the vessels just to the side of the cervix (Fig. 24), and should get some grip in cervical or vaginal tissue for traction purposes.

Now one may with advantage repeat the procedure from the opposite side (Fig. 25). And for this reason. These suture-ligatures make convenient cervix tractors, and we may often dispense entirely with other clamps than those used to prevent reflux bleeding. Next, the uterus is cut away, taking care to cone the cervix in such fashion as to leave little or no cervical canal (Fig. 24). The cervix stump swings between two tractors, namely, the ligatures. One of these next approximates the two faces of the cervix crater, taking care to turn into this raw surface the cut ends of the round ligaments (Fig. 26), and it is then tied to its fellow of the opposite side. Finally, the second suture becomes the peritoneal suture and closes in all raw areas (Fig. 29). At any step in the process one may tie the strands, then go on with them. When the cervix is to be removed the same procedure holds good, substituting the words vaginal edge for cervix crater.

The same principle is applied to large uterine and ovarian tumors and pus-tubes, and to broad ligaments however distorted, by a variation in the procedure. Whenever there would be, between one artery and the next, a gap or space, and this would be crossed by a span of suture that could not be drawn taut, each artery can be securely grasped without altering the principle of this method.

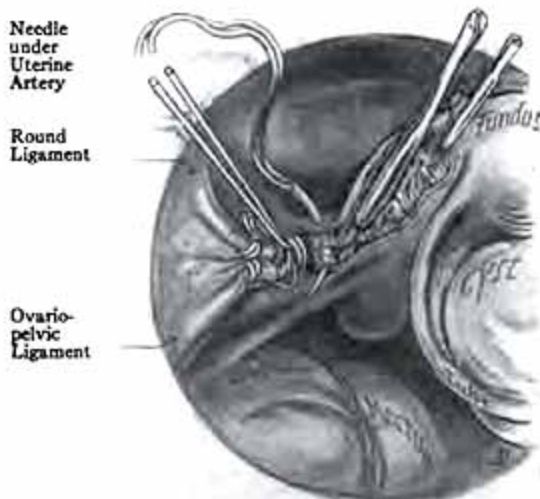


Fig. 27.

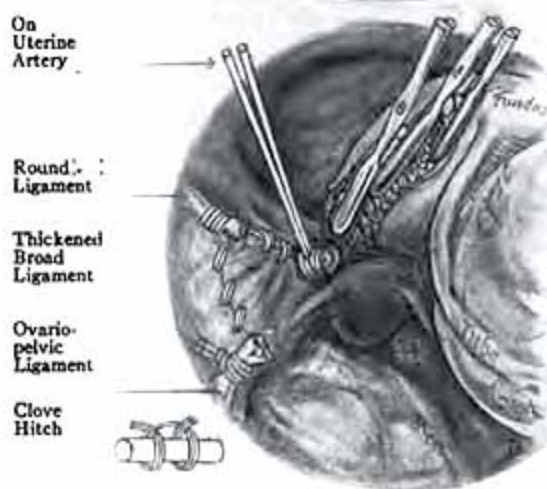


Fig. 28.

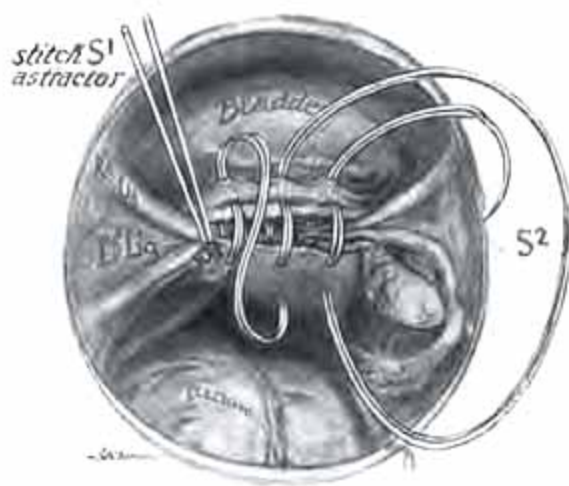


Fig. 29.

Figs. 27, 28, 29. View into pelvis—stitches drawn large—to show closure of broad ligament at each step of ligation, and effective tractor action. Fig. 28, double bite, or clove hitch, used when any slack or line of delicate stitching intervenes between ligature action. Fig. 29. Peritoneal apposition over stump.



Figs. 30-31. The continuous double suture climbs the broad ligament; the second loop, here nestled home,

The vessel is to be caught in one loop, and afterward by a second—the second locking the first by the familiar clove hitch (Fig. 28).

Thus between the location of secure ligatures on several vessels, there can be lines or areas of mere suturing, all cared for by the same running strands (Fig. 28). The advantage is not only simplicity and speed, but also this: one does away with the curious and general practice of laying open wide raw spaces of connective tissue and then covering them in later. By coapting before cutting—or immediately on cutting—one closes the denuded areas, as it were, before creating them.

Vaginal Hysterectomy. The drawbacks to the lower route have been slowness and fussiness; occasional slipping of ligatures; oozing from broad ligament bases that spread wide open and retract into the bloody dark, and wide raw areas left uncovered by peritoneum.

If, by means of a long suture-ligature-tractor for each side—of fine, plain catgut, doubled—one sweeps about the vessels while



circles uterine artery (UA). Second cut of ligament has been made. Tractor action shown. Fig. 30—A small fundus may be extracted, then round ligament, then tube and ovarian vessels grasped by lock stitch. Or uterus may first be bisected. Or, on upper section of broad ligament, lock stitch may follow clamp and cut.

he closes together and climbs and pulls down broad ligament, all by steps in the same process, then cuts the uterus out; thereafter, with one of the same stitches sews the ligament masses together, closes the peritoneum of the cul-de-sac, and cares for the posterior vaginal gap; with the other unites the anterior peritoneum, anchors the bladder, and cares for the longitudinal vaginal incision, all by running continuous suture,—he has, by a succession of well-reasoned movements, planned for the four requisites. The steps are as follows:

After the bladder is pushed back and the cul-de-sac opened and the base of broad ligament seized, cervix and stitch are pulled in different directions and a cut made between. This, or a second loop and cut, takes us close to the uterine artery. This sweep bites into tissue to anchor it and then circles the artery, is looped and carefully nestled home, and kept taut by the assistant (Fig. 30). Rarely a second, or locking loop, is applied. Next, the opposite side is treated in the same way. Now the uterus comes down so that the anterior



Fig. 32.



Fig. 33.



Fig. 34.

Figs. 32, 33, 34. Quilted broad ligaments ready to be sewed together. After anterior peritoneum is closed (not shown), bladder is sutured to top or rear of this strong

bridge, Fig. 31. Cul-de-sac whipped over, then transverse and longitudinal vaginal openings approximated, catching the vagina up to the ligaments also.

peritoneal pouch is accessible for opening and widening. The fundus is drawn out. The suture either takes two more bites, round ligament in one (Fig. 31) and tube and ovarian ligament in the other before one side of the uterus is cut free, or else a clamp is applied, and after the uterus is out these stitches are taken. One must be careful to puncture and grip good tissue to prevent slipping,—for example, in the ovarian ligament. The upper end is now tied, shortening the broad ligament. The suture is not cut, however. The opposite side is treated in the same fashion. Care must be taken that in the jump between the ligating loops safe-guarding the lower portion of the broad ligament and those controlling the ovarian and round ligament vessels, there be no slack or span. The stitch should now be tied, and then continued to sew broad ligaments together, make fast the bladder and close the vaginal incisions.

CONCLUSION

If in all other workshops time, study, and analysis have resulted in doubling, with the same expenditure of energy, the output of the worker or cutting in half the time required to do a certain piece of work,¹ then the activities of all concerned in operating room and ward must be subjected to such study. Otherwise the profession is neglecting its plain duty. It now behooves us to call in the expert on scientific management to apply in our business of saving life and health whatever may be transferred from his experience in other fields. Each one of us may help by recording analysis and experiment in his own particular province, in those matters, such as details of operation, of which no outsider could be expected to have sufficient understanding.

¹ Gilbreth, *Primer of Scientific Management*, 1912.