

GANGRENOUS INTUSSUSCEPTION IN A CHILD
FOUR YEARS OLD; INTESTINAL RE-
SECTION; RECOVERY.

THE VALUE OF END-TO-END SUTURE WITH AN INNER ROW OF
STITCHES THROUGH ALL THE LAYERS OF THE INTES-
TINE AND AN OUTER ROW THROUGH
THE OUTER LAYERS.¹

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RECOVERY from irreducible intussusception is unusual. In 1897 Gibson (*New York Medical Record*, July 17, 1897) tabulated with great care all the cases of intussusception which he could find recorded in medical literature,—239 in number,—and in this entire list there is no record of recovery from non-reducible intussusception in a patient under seven years of age, and there are only nine such recoveries in older patients.

In a subsequent paper in which he studied the results of 1000 operations for acute intestinal obstruction and gangrenous hernia (*ANNALS OF SURGERY*, October, 1900, p. 497), he considers the operations for intussusception of various grades: 1. Reducible; 2. Irreducible (not septic); 3. Gangrenous; and makes the following statement: "When we encounter the third variety, gangrene of the intussusception, we are confronted with a state so severe as to be almost beyond the hope of relief." "Free extirpation of the intestine is called for, an operation which in these desperate cases is practically

¹Read before the Surgical Section of the New York Academy of Medicine, December 9, 1901.

always fatal." He found only one case of recovery after resection of gangrenous intussusception.

Braun (*Verhandlungen der deutsche Gesellschaft für Chirurgie*, 1885), studying the subject in 1885, could find no record of cure of non-reducible intussusception either simple or gangrenous.

CLINICAL HISTORY OF PATIENT.

The history of the patient, who was shown before the Surgical Section of the Academy of Medicine in a condition of vigorous health, is as follows:

He had always been well until May 24, 1901, when he began to have abdominal pain and discomfort. He was then four years and four months old. The pain and discomfort continued for ten days, during which time he had no movement of the bowels, although repeated enemata were given. He vomited frequently throughout the time. For five or six days the vomitus had appeared like the contents of the small intestine. He had been losing weight and growing weaker all the time.

Physical Condition.—When seen June 3 he was extremely emaciated; the abdomen was greatly distended, and tympanitic everywhere. There were several irregularly transverse ridges which indicated the position of the distended intestine. No peristalsis was evident. Rectal examination simply showed the distended viscera pressing backward from in front. Pulse, 120; temperature, 100° F.; respiration quiet. The facies indicated weakness, but no acute inflammation.

Operation was advised immediately, and was done at 10 P.M., at St. Mary's Free Hospital for Children. A median incision about four inches long was made below the umbilicus. The abdominal wall was very thin; coils of intestine which were greatly distended rolled out of the incision as soon as it was made; they were congested but not inflamed. An intussusception was found about the middle of the ileum; it was about two and a half inches long. The intestine below this was empty. On gentle manipulation, an opening appeared through the intestinal wall, which was gangrenous at the site of intussusception. The intussusception, two or three inches of intestine at each end of it, and a gangrenous piece of the mesentery were excised. A large

amount of gas escaped from the upper intestinal end; also intestinal contents about the color and consistency of pea soup. After this the coils of intestine which had been so greatly distended, and which had been kept in hot moist towels, could be returned into the abdomen. The intestine about the excised portion was washed repeatedly in warm saline solution. A circular enterorrhaphy was then done. The first row of stitches passed through all the layers of the intestine and brought the peritoneal surfaces into close apposition at the margin. At the mesenteric border they were so placed as to obliterate the dead space there and hold broad peritoneal surfaces together, well supported by intestinal wall. A second row of Cushing stitches was then taken outside of this, and this was in certain places reinforced by a third tier of similar stitches. The intestine was then returned into the abdomen, and thorough irrigation with hot saline solution given. The abdominal incision was closed with tier sutures. Intravenous infusion of hot saline solution, one and a half pints, was given, and the patient put to bed in fairly good condition.

The bowels moved on the next morning, and recovery was uneventful, excepting for a small mural abscess. The child ate ravenously, gained strength rapidly, was out of bed in four weeks, and two weeks later went home. He has continued well ever since.

CONSIDERATION OF SYMPTOMS.

The clinical picture which this child presented was so striking that I venture to call attention to it again. He showed in a most exaggerated degree the symptoms of prolonged intestinal obstruction, viz., constipation, persistent vomiting of intestinal contents, tympanites, emaciation, the retention of a good temperature, and a fairly good pulse.

He had not had a passage from the bowels in ten days. He had repeatedly vomited material from the intestine, thin, grayish, containing small particles of partially digested food. Tympanites was excessive, so that there were ridges across the abdomen which indicated the position of the distended coils of intestine. He had become so emaciated that his appearance suggested the famine pictures from India. Yet in spite of these exaggerated symptoms there was only moderate

constitutional depression. On the very day of the operation, he had asked for peanuts, and had eaten them; he did not stay in one bed all the time, but went from bed to couch. His temperature was only 100° F. and his pulse-rate 120, —not unduly rapid for so young a child,—and it had been less frequent until that day. He was really suffering from starvation and intestinal distention, the effects of the mechanical obstruction of the intestine, and the picture which he presented was a most vivid one.

Of course there is the gravest possible danger when the symptoms have reached this exaggerated state. It is remarkable that perforation of the intestine had not occurred. In a similar case which I have since seen, in whom operation was refused, a fatal perforation occurred on the sixth day.

METHOD OF CARING FOR THE GANGRENOUS INTESTINE.

This case suggests several topics which are important in the management of irreducible intussusception. I will, however, ask your attention to only two:

I. Intestinal Resection *versus* the Making of an Artificial Anus.

II. The Method of Uniting the Ends of the Resected Intestine.

Intestinal Resection versus Artificial Anus.—The formation of artificial ani is fast losing favor, and is not to be recommended in the treatment of intussusception. One can imagine cases of dire urgency in which it would be permissible; but they must be very rare; for the diseased intestine in intussusception is not adherent in an opening in the abdominal wall as it sometimes is in strangulated hernia, and it takes almost as long to fasten the divided intestinal ends into the abdominal opening as to fasten them to each other.

Recovery after intestinal resection is usually complete. Recovery after the formation of artificial anus is protracted. The patient is left in an uncomfortable and even precarious condition. Unless the opening is in the lower part of the intestine, life is maintained with difficulty; and even then there is

an irritating and disagreeable discharge and the necessity of a secondary operation or other surgical procedure.

In the six secondary operations for artificial anus after intussusception which are recorded in Gibson's statistics there were three deaths (50 per cent.); and other reports of operation for the relief of artificial anus indicate a high mortality rate. The most favorable results have probably been obtained by resecting the portion of intestine in which the opening exists and uniting the divided ends. By this method Delore and Patel (*Centralblatt für Chirurgie*, 1901, p. 1107) record thirteen cases with two deaths (15.4 per cent. mortality). If this is to be done, it is manifestly desirable to do it at the time of the original operation. The conditions for doing it are not likely to be improved by delay.

The relative advantages of intestinal resection and the making of artificial ani have recently been considered with great care by Peterson (*Centralblatt für Chirurgie*, 1893, p. 62) in a report upon the cases of gangrenous hernia in Czerny's clinic in Heidelberg, 1877-1900. He reports a mortality of 67 per cent. in twenty-two cases in whom artificial ani were formed, while the mortality was 33 per cent. in twenty-eight cases treated by intestinal resection. He also quotes the following statistics:

ARTIFICIAL ANUS.

Mikulicz	94 cases, mortality	72 = 76.6 per cent.
Hofmeister	167 cases, mortality	101 = 60.5 per cent.

RESECTION.

Mikulicz	68 cases, mortality	32 = 47.1 per cent.
Hofmeister	214 cases, mortality	99 = 46 per cent.

Zeidler grouped 269 cases of resection and 213 cases of artificial anus, and studied all obtainable histories in order to determine whether the greater mortality in the latter could be due to their condition before operation; he found that it seemed due to conditions dependent on operation and not to conditions prior to operation. He suggests the probability that an additional 17 per cent. of the artificial anus cases could

have been saved if intestinal resection had been practised. His table is as follows:

	Intestinal Resection	Artificial Anus.
Number of cases	269	213
Fatal cases	122	139
The mortality rate is thus recorded:		
(a) Accidental cases	6.32 per cent.	3.76 per cent.
(b) Collapse and peritonitis which existed before the operation	19.33 per cent.	24.88 per cent.
(c) Secondary peritonitis and infection	15.95 per cent.	20.66 per cent.
(d) Other complications ac- companying the oper- ation (narrowing of intestinal lumen, ex- haustion, inanition) ..	2.60 per cent.	11.77 per cent.
(e) Result of secondary operation	1.11 per cent.	4.22 per cent.
1. Independent of operation (Groups a and b)	25.65 per cent.	28.64 per cent.
2. Following operation (Groups c, d, and e)	19.66 per cent.	36.62 per cent.

In consideration of these reports, many of them made before intestinal resection was practised as successfully as it is now, one hardly feels justified in making an artificial anus in gangrenous intussusception.

Method of Uniting the Ends of the Resected Intestine.—

There are many methods of uniting the ends of the resected intestine. The vast amount of work which has been done on the subject is indicated in the careful review which von Frey (*Beiträge zur klinischen Chirurgie*, 1895) published in 1895, in which he described eighty-one different methods. Since then others have been added to the list.

In the earlier cases the edges of ruptured or resected intestine were brought together without special reference to the approximation of the serous surfaces; stitches were brought through the opening in the abdominal wall, and, if the case recovered, more or less leakage and a temporary or permanent fæcal fistula were expected.

In 1826 Lembert ("Répertoire Général d'Anatomie et de Physiologie," Path. et de Clin. Chir., Tome II, First Part, p. 100, Paris, 1826) enunciated the principle that serous surfaces should be brought together in order to obtain rapid and firm union, and devised a method of suture to accomplish this. This suture, which is known by his name, is still in general use, and the importance of bringing the serous surfaces together is universally recognized.

The term "Lembert suture" is frequently applied to any form of suture which brings the serous surfaces together without penetrating the mucous membrane, but it is perhaps better to apply it to the interrupted suture which he described. His needle penetrated the serous and muscular layers and passed between the muscular and mucous layers. He did not refer to the submucous layer; but the stitch as he used it must have frequently included it. In certain instances he stated that it even penetrated the mucous membrane. Halsted (*American Journal of the Medical Sciences*, October, 1887; *Johns Hopkins Hospital Bulletin*, January, 1891) has particularly called attention to the importance of including the submucous layer in the stitch, as the fibrous structure of this layer prevents the tearing out of the thread.

It is not necessary at this time to describe in detail the numerous methods of suture which have been devised. The articles of von Frey and Senn (*Journal of the American Medical Association*, August 12, 1893) may be referred to for these descriptions.

Exquisite ingenuity has been shown in the invention of artificial aids either to hold the intestine together or to form a support while stitches were being placed. The Murphy button, the one of these aids which is in most general use, is easily and quickly applied, and gives in most instances a firm and satisfactory union. Its use has greatly reduced the mortality rate. The mortality was 19 per cent. in 750 cases of entero-enterostomy collected by one of Murphy's assistants and reported by Murphy (*Philadelphia Medical Journal*, 1900, p. 1271) at the American Medical Association in 1900, or 14.4 per cent.

in the non-malignant cases. The great majority of surgeons prefer its use to all other methods of uniting the ends of resected intestine.

There are, however, certain conditions in which its use is impracticable or inconvenient; for instance, in this case the intestine above the intussusception had been greatly distended for several days; its diameter was about two and a half inches. The difficulty of fitting its end to a seven-eighths inch Murphy button would be greater than the difficulty of doing an end-to-end suture, and a Murphy button seven-eighths inch in diameter is a close fit for the ileum of a child of four; it distends it considerably in the cadaver of such a child.

Again, these are operations of emergency, and there are many instances where the proper sized button—or, in fact, any other artificial appliance—is not at hand. Then there are advantages in avoiding the leaving of a large foreign body with a small lumen in the intestine. There will always be use for a simple and secure method of end-to-end suture with no artificial aid but thread and needle. I say *end-to-end* suture because, in those parts of the intestine which have a mesentery, it is simpler than lateral anastomosis or lateral implantation, and gives less likelihood of cicatricial stenosis.

There are numerous methods of end-to-end suture; of these the Czerny-Lembert suture has probably been the one most generally used,—a row of inner sutures uniting the mucous membrane, and a row of Lembert sutures outside of this. The difficulties in its use are: (1) The mucous membrane tends to evert so that mucous surfaces are brought together. These will not unite quickly, and hence the integrity depends upon the external row of Lembert sutures. (2) The mesenteric border is a particularly weak spot. The strip of intestinal wall which is left uncovered by peritoneum here is usually a little more than one-fourth inch wide, and the union of the mucous surfaces cannot be relied upon to prevent leakage at this point, nor can the thin layers of peritoneum be relied upon to retain the material which leaks through the intestinal wall.



FIG. 1.—Intestine united by modified Czerny-Lembert suture, showing (1) the firm union which had formed in most of the suture line within twenty hours; (2) perforation and leakage at the mesenteric border.

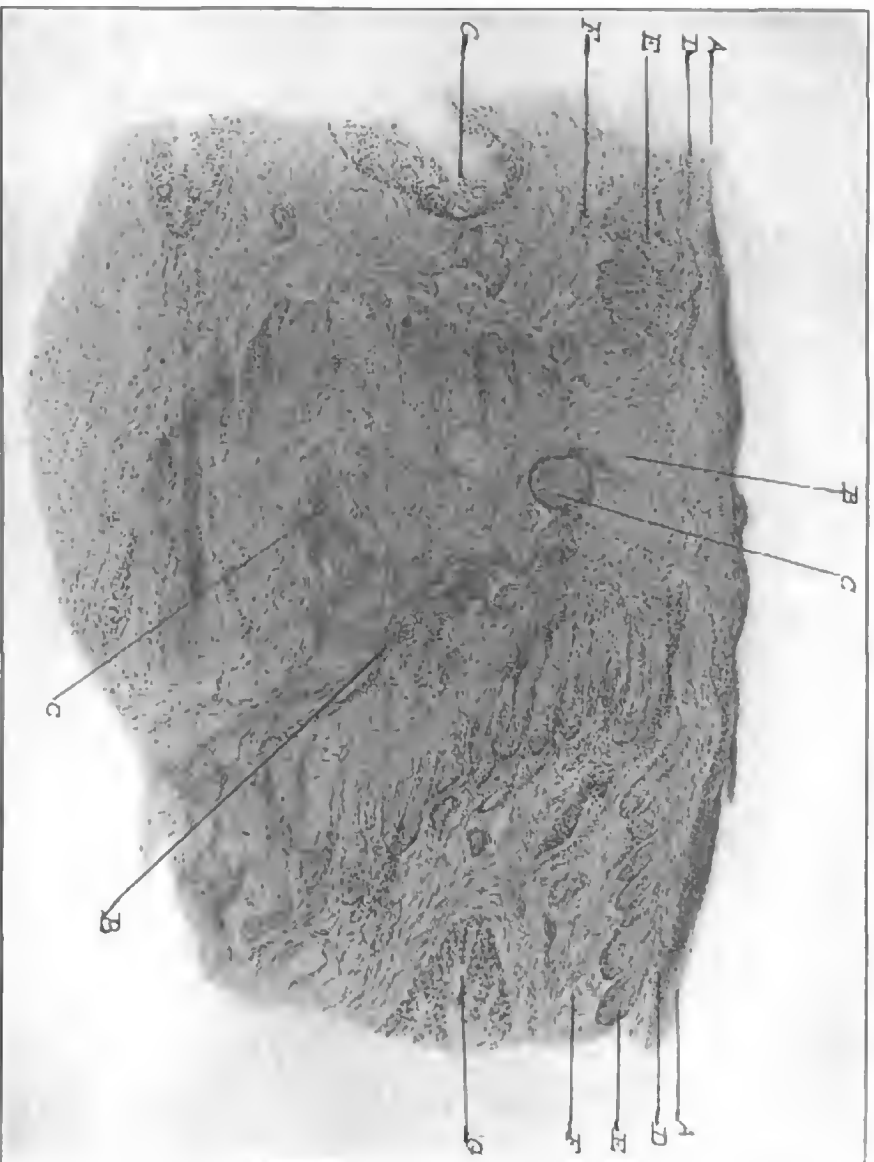


FIG. 2.—Microscopical picture of a longitudinal section of sutured intestine showing firmness of peritoneal exudate twenty hours after operation. A. Peritoneal cover of intestine. B. Peritoneal exudate filling space between surfaces of inverted intestines. C. Section of silk suture. D. Longitudinal muscular layer of intestine. E. Circular muscular layer of intestine. F. Submuscular layer of intestine. G. Mucous membrane.

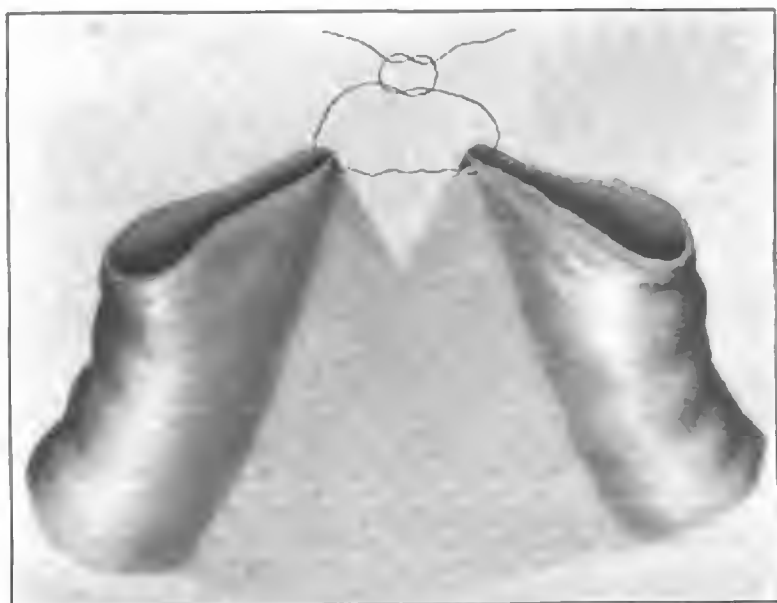


FIG. 3.—First stitch, taken through all the layers of the intestinal wall, and through both the layers of the peritoneum which are reflected from the intestinal wall to form the mesentery. A similar stitch is at once taken through the intestinal wall on each side of this one to strengthen the union at this place.

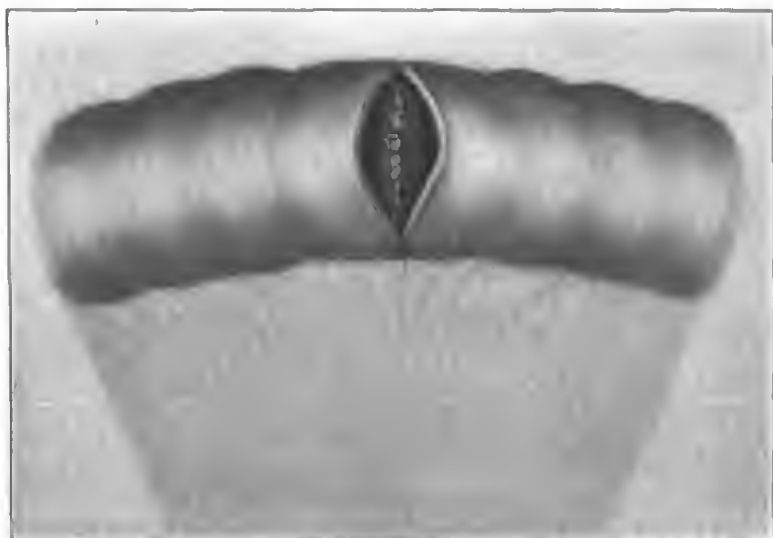


FIG. 4.—Appearance of the intestine when two-thirds of the first row of stitches have been taken.

Some time ago a specimen came into my possession which is most instructive in the study of intestinal repair. It was taken from a patient upon whom another surgeon had done a Czerny-Lembert end-to-end suture for gangrenous hernia on the preceding day. He had, however, taken continuous instead of interrupted sutures. The patient died twenty hours later. This specimen, which is here figured (Figs. 1 and 2), shows, first, the remarkable union of peritoneal surfaces which had taken place in so short a time in most of the suture line. Second, the leakage at the mesenteric border. Any one studying it must appreciate the importance of so arranging intestinal sutures that they will hold the serous surfaces firmly together and give them the support of the stronger portions of the intestinal wall; the peritoneal exudate quickly seals the line of union, and if there is a firm support pressing the layers of the intestine against it, leakage is impossible and a strong union soon follows.

Can we put our sutures through the entire intestinal wall in order to gain this firm support? This seems to me the most important question concerning intestinal sutures at the present time, and the answer should be, Yes.

In order to call attention to the desirability of using these through and through stitches, and re-enforcing them by an outer row of superficial stitches, the method which was used in this case is here figured.

The first stitch was taken at the mesenteric border: it passed through the entire intestinal wall and through both layers of the peritoneum as they pass from the intestinal wall to form the mesentery (Fig. 3). When it was tied, the peritoneal surfaces were in close apposition and had the support of the entire thickness of the intestinal wall. A stitch was at once taken on each side of this to strengthen the union, and then a row of stitches about the entire circumference of the intestine, entering the mucous membrane one-eighth or three-sixteenths inch from the cut margin and emerging from the serous coat, then entering the serous coat of the other intestinal end at a corresponding place, and emerging from the mucous membrane. These stitches passed over the inverted edge of the intestine and were tied there. A knot was made after every third insertion of the needle (Fig. 4). These knots were formed by tying the free end of the thread,

which was left protruding from the stitch-hole, with the double thread which emerged from the other side of this hole. If one of the threads leading from this knot is left uncut, the stitching may be continued with the same needle and thread.

There is no difficulty in inserting these stitches without especial appliances; mouse-tooth forceps, sewing silk, and needle are all the appliances needed. While the stitches are being placed, the edges of the intestine may be held taut with the mouse-tooth forceps or a silk thread. The manner of inserting the last stitch is shown in Fig. 5. After its insertion, the stitches need in no place be more than one-eighth inch apart, and the peritoneal surfaces are in firm apposition throughout the entire circumference of the intestine.

This row of stitches was then re-enforced by an outer row (Fig. 6) of Cushing sutures which included the serous, muscular, and submucous layers, and which were knotted after every third or fourth insertion of the needle.

This method, although worked out independently, possesses the essential elements of the method of Frank (von Frey, *loc. cit.*), viz., an inner row of stitches through all the intestinal coats and an outer row of superficial stitches. Many of the knots of his inner row of stitches, however, are left on the serous side; a real disadvantage, as they increase the danger of abscess formation there. The stitches of his outer row are also taken by a less rapid method than Cushing's.

The method described by Lilienthal in his excellent book on "Imperative Surgery" also has the same essential features; but the stitches of his inner row are only six or eight in number, are interrupted, and are called "anchor sutures." Their purpose is "to draw the cut ends of the intestine together," not to make a firm apposition of the peritoneal surfaces about the entire circumference of the cut intestine. The main dependence must therefore be placed upon the second row of stitches, which are accordingly made with a separate thread for each stitch, a much slower method than Cushing's.

There is certainly an increasing tendency to take certain stitches through the entire intestinal wall, and the advocating

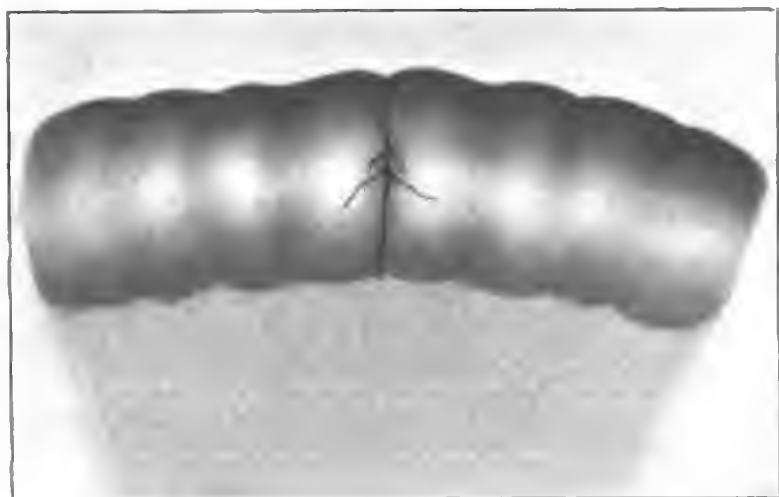


FIG. 5.—Last stitch of the first row; ends to be pushed into the lumen of the intestine after knot is tied.

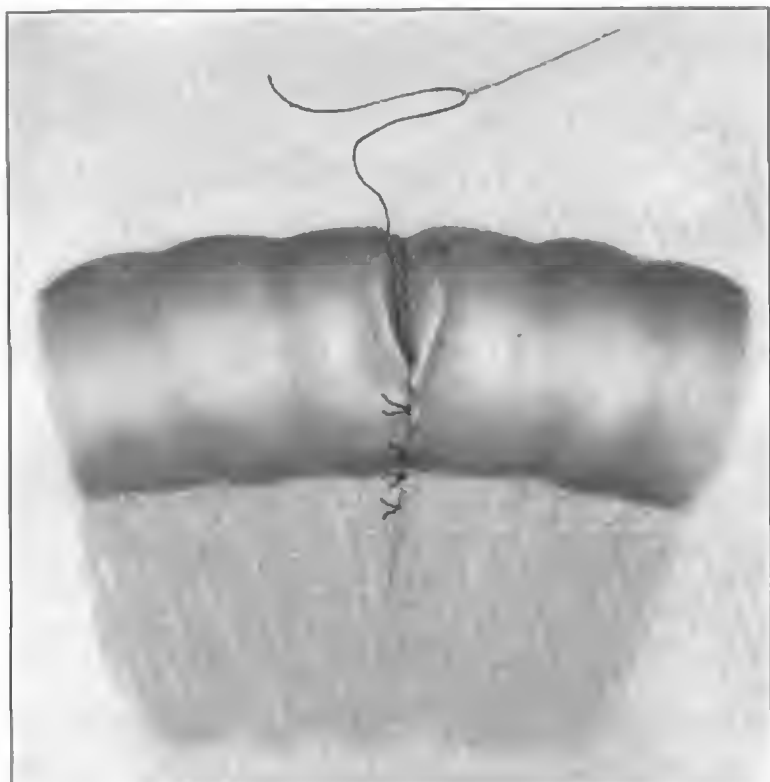


FIG. 6.—Second row of stitches taken by Cushing's method, knotted after every third or fourth insertion of the needle.

of such stitches by Lilienthal and Frank is of much importance in the development of the subject.

The results of other methods in which through and through stitches are used also bear on the subject and should be given. Maunsell (*American Journal of the Medical Sciences*, March, 1892) depended on a single row of such stitches so placed as to bring the peritoneal surfaces at the margin in firm apposition. In thirty-one reported cases in which this method was used there were only three deaths. Some of the operators, however, did not depend entirely on this single row of stitches, but re-enforced them by a second row of superficial stitches. M. E. Connell (*New York Medical Record*, September 17, 1892) has used a continuous through and through stitch which brings the peritoneal surfaces together at the margin of the cut intestine, and F. G. Connell (*Journal of the American Medical Association*, October 12, 1901) and Bishop (*Medical Chronicle*, September, 1885) have devised a similar method in which interrupted stitches are substituted for the continuous one. No re-enforcing stitches are used in either of these methods; yet a report of nineteen cases in which they were used gives only four deaths, and of these four three were reported as due to shock; the fourth occurred eight days after operation, and the autopsy showed the line of suture intact.

In operations on animals this method gave 100 per cent. recovery, or 97 per cent. recovery done in the hands of graduate students.

Taking into consideration all the possibilities of error in statistics which are taken from various operators instead of from a single institution, we may feel that the results are favorable to the use of through and through stitches. Most surgeons, however, do not feel it safe to leave such a row of stitches without re-enforcing them by a second row of superficial ones. When so re-enforced, any infection which might follow the stitch is much more likely to work its way into the lumen of the intestine along the thread than to push the peritoneal adhesions apart and force its way into the peritoneum. We have, in fact, after the application of such stitches, the

conditions which, according to Edmunds and Balance (*Medico-Chirurgical Transactions*, lxxix, p. 254), exist after the application of Lembert sutures; for they found in autopsy examinations on a man and on dogs, which were made two or three weeks after the application of Lembert stitches, that the stitches were working into the lumen of the intestine, and were hanging, partly inside the intestine, partly in the intestinal wall. Yet we would not think that these stitches were likely to cause peritonitis. The infection would naturally follow the course of least resistance—towards the intestinal lumen.

There can be no question but the lumen of the intestine is frequently entered in taking stitches designed to include nothing below the submucous layer. The submucous layer is about one-two-hundredths of an inch in thickness; and it is manifestly impossible to insert a needle through the muscular coating and include this layer alone without occasionally piercing the mucous layer. Yet this seldom does any harm, even though the knot is on the outside instead of on the inside.

The time consumed in applying these two rows of stitches differs little from that required for the application of a Murphy button. The suturing can be completed in ten minutes; in fifteen minutes it can be done without hurrying.

One may ask whether this double row of stitches produces a diaphragm and consequent constriction within the intestine. The experiments of Edmunds and Balance answer this question in a most satisfactory manner. They used various methods of intestinal union to determine the amount of diaphragm formation or cicatricial contraction which results, and found that the Maunsell suture, re-enforced by the Lembert suture, gave practically no diaphragm. This method gives the same conditions as the Maunsell method, with the re-enforced row of Lembert sutures, the only difference being that the inner row of stitches is applied without making the longitudinal cut in the intestine or invaginating one intestinal end into the other. Hence, we need have no fear of diaphragm formation. The vascularity is so great that the blood supply is not cut off; the tissues about the stitches retain their pinkish color.