

Finally, there are several matters of interest in regard to typhoid cholecystitis. Among the 216 patients whose cases Dr. Kelly had studied, there were seven (all women) from whose gall bladders the typhoid bacillus was isolated. "In four no history of previous typhoid nor of concurrent typhoid fever (in the commonly accepted sense) could be obtained." When the symptoms of acute cholecystitis occur during the course of typhoid fever the question of operative interference naturally arises, but in most cases I think it is wise to treat these patients medically unless very positive evidence exists that the cholecystitic process has gone on to suppuration or to some more serious complication.

Not infrequently an enlarged and tender gall bladder can be detected during typhoid fever without there being any subjective signs of cholecystitis. And as it is extremely probable that the typhoid bacilli invade the biliary tract in nearly every case of typhoid fever, the only wonder is that this disease has not heretofore assumed more importance as a predisposing cause of cholecystitis and gallstone formation. I do not know what proportion of patients with infections of the biliary tract give a history of previous attacks of typhoid fever, nor whether the incidence of gallstone disease is greater among such individuals than among the populace at large, but it certainly seems that it will be important for us in the future to inquire into these matters. Patients who have given evident symptoms of biliary involvement during typhoid fever should, if possible, be operated on by cholecystostomy after their recovery if any symptoms persist. Not only may serious future disease be thus prevented in the patients themselves, but the dissemination of typhoid infection from their intestinal tracts will be more effectually prevented. Drainage to accomplish good in infection of the biliary tract must be instituted early and be prolonged. It is in this class of cases in particular that I insist on and carry out tubage, not only of the gall bladder, but of the common duct as well. The mortality after the use of tube in the common duct is no greater in my hands than is that of the gall bladder.

I append the statistics as compiled by Dr. Kelly of the 216 cases referred to as operated on in the German Hospital:

DR. KELLY'S STATISTICS.

- Of 216 patients:
182 (84.2%) had gallstones, and
34 (15.8%) had no gallstones.
- Of 182 patients that had gallstones:
101 (55.5%) had stones in gall bladder alone;
23 (12.5%) had stones in gall bladder and cystic duct;
19 (10.5%) had stones in gall bladder and common duct;
12 (6.6%) had stones in common duct alone;
11 (6.0%) had stones in cystic duct alone;
5 (2.8%) had stones in gall bladder, cystic, hepatic and common ducts;
4 (2.2%) had stones in gall bladder, hepatic and common ducts;
1 (0.6%) had stones in gall bladder, cystic and common ducts;
2 (1.1%) had stones in adhesions (not otherwise specified);
4 (2.2%) had stones in regions not definitely specified.
- Of 216 patients:
58 had no stones in gall bladder, and of these
23 had stones in the ducts;
41 had stones in common duct, and of these
12 had stones nowhere else;
9 had stones in hepatic ducts (as well as elsewhere).
- Of 216 patients:
123 (56.9%) had adhesions about gall bladder;
22 (10.1%) had no adhesions, and of
71 (33.0%) there is no note in the case histories of presence or absence of adhesions.
- THE PAINS.
- Of 216 patients:
161 (74.5%) had colicky pains;
45 (20.8%) had non-colicky pains;
7 (3.3%) had pain not accurately described; and
3 (1.4%) had no pain whatever (one was markedly jaundiced, and the other two had fever, 100 and 104.6 respectively).
- Of 161 patients that had colicky pains:
137 (85.1%) had gallstones, and
24 (14.9%) had no gallstones.

- Of 45 patients that had non-colicky pains:
35 (77.7%) had gallstones, and
10 (22.3%) had no gallstones.
- Of 3 patients that had no pains whatever, 2 had gallstones
15 patients never had colicky pains nor jaundice, and of these,
12 had gallstones, and
3 had no gallstones.

THE JAUNDICE.

- Of 216 patients:
138 (63.0%) had jaundice at some time or other;
74 (34.2%) never had jaundice; and of
4 (1.9%) there is no statement as to occurrence of jaundice.
54 (14.0%) had jaundice at operation and previous attack;
13 (6.0%) had jaundice at operation and no previous attacks;
67 (31.0%) had previous attacks of jaundice, but no jaundice at operation;
4 (1.9%) had jaundice at operation, but there is no note as to whether or not there were previous attacks;
71 (32.8%) had jaundice at operation;
141 (65.3%) had no jaundice at operation;
121 (56.0%) had attacks of jaundice prior to the time of operation;
116 (53.7%) had jaundice and gallstones;
21 (10.0%) had jaundice, but no gallstones;
60 (27.2%) had gallstones, but no jaundice;
11 (5.0%) had no gallstones and no jaundice; and in
8 (3.6%) there is no statement as to the association of jaundice and gallstones;
12 (5.5%) had jaundice and colicky pains, but no gallstones.
- Of 60 patients that had no gallstones, but no jaundice:
44 (73.3%) had colicky pains;
12 (20.0%) had non-colicky pains; and in
4 (6.7%) the character of pain is not accurately described.
- Of 11 patients that had no jaundice and no gallstones:
8 (72.7%) had non-colicky pains, and
3 (27.3%) had colicky pains.
- Of 34 patients that had no gallstones:
12 (35.3%) had no jaundice at operation, but did have previous attacks;
11 (32.4%) never had jaundice;
9 (26.5%) had jaundice at operation and previous attacks;
1 (2.9%) had jaundice at operation, but no previous attacks;
1 (2.9%) there is no statement as to occurrence of jaundice.

THE SIZE OF THE GALL BLADDER.

- Of 216 patients, in:
88 (40.7%) gall bladder was enlarged;
9 (4.1%) gall bladder was normal in size;
32 (15.0%) gall bladder was small and atrophic; and in
87 (40.2%) size of gall bladder is not mentioned in case histories.
- Of 88 patients in whom gall bladder was enlarged:
74 (84.0%) had gallstones, and
14 (16.0%) had no gallstones;
49 (55.6%) had jaundice;
36 (41.0%) had no jaundice; and in
3 (3.4%) the presence or absence of jaundice is not mentioned.
- Of 9 patients in whom gall bladder was normal in size:
7 (77.7%) had gallstones, and
2 (33.3%) had no gallstones;
7 (77.7%) had jaundice, and
2 (33.3%) had no jaundice.
- Of 32 patients in whom gall bladder was small and atrophic:
30 (93.7%) had gallstones, and
2 (6.3%) had no gallstones;
25 (78.1%) had jaundice, and
7 (21.9%) had no jaundice.
- Of 87 patients in whom size of gall bladder is not mentioned:
71 (81.6%) had gallstones;
16 (18.4%) had no gallstones;
57 (65.4%) had jaundice;
29 (33.4%) had no jaundice, and in
1 (1.1%) presence or absence of jaundice is not mentioned.

CAPILLARITY IN INTESTINAL SUTURES.*

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The histology of intestinal repair has been most comprehensively studied and described by many investigators, such as Warren,¹ Senn,² Murphy³ and many others. The strength of the union has been determined by its resistance to hydrostatic pressure, in the observations of

* Read in the Section on Surgery and Anatomy of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.

1. J. Collins Warren: "The Process of Repair After Resection of the Intestine and Intestinal Suture," Trans. Amer. Surg. Assoc., May 12, 1887.

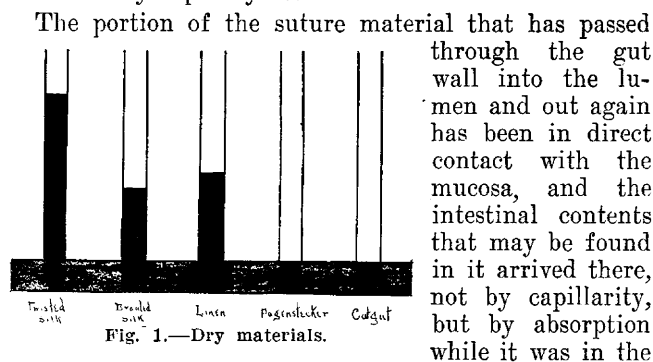
2. N. Senn: "Intestinal Surgery"; Annals of Surgery, June, 1888.

3. J. B. Murphy: "Intestinal Approximation. Pathologic Histology of Reunion," Chicago Clin. Rev., June, 1894.

Chlumsky⁴ and of Horsley.⁵ The capillary action of the suture material has been spoken of by many writers, but no experimental data have been noted in available literature.

The subject of capillarity in intestinal suturing is worthy of consideration and study, for the reason that the fear of infecting the peritoneal cavity by capillarity has been the cause of attempts to include but a part of the intestinal wall in the bight of the stitch and, in consequence, the introduction of stitches that have yielded and so proved to be insecure.

Capillarity in this connection is generally understood to mean the seepage, creeping or extending of a fluid along the suture material beyond the portion that is in the lumen and in direct contact with the fluid. The portion of the suture in direct contact absorbs the fluid; but if it is carried beyond the line of contact or of submersion it is brought there by capillary action. In the intestinal stitch that portion of the suture in the lumen is in direct contact with the mucosa or the intestinal contents, and the presence of such material in it is due to the absorptive powers of the suture material. But if intestinal contents are found in the portions of the suture other than that which is in the lumen it has been taken there by one or two ways: either by absorption while being drawn through the lumen or by capillary action.



lumen of the gut. Such a condition is present in at least part of each perforating intestinal suture.

By capillarity is implied a continuous action, a progressive flow, from that portion of the suture within the lumen and in contact with the mucous surface to that part on the serosa. This action is supposed to be constantly bringing to the serosa fresh material from the lumen, and it is this seepage, this continual replenishment of the objectionable matter, that has been feared in intestinal suturing.

In the consideration of this subject and in an effort to arrive at a more definite understanding as to the capillary properties of the different intestinal suture materials usually employed in the various methods, the following experiments were made:

EXPERIMENT 1.—The dry materials, ordinarily employed in gastrointestinal surgery, were tied around a frame, and this was placed upright in a saturated aqueous solution of methyl blue, in such a manner that about an inch of the suture materials were submerged. The capillary powers of the threads were then noted, by observing the distance that the color was carried, above the surface of the liquid.

The colored fluid was found to have risen highest in the

twisted silk; linen, braided silk, and Pagenstecher thread in the order named. Catgut, especially that prepared by the Bartlett process, had practically no capillary action. (Fig. 1.)

That portion of the suture material which was surrounded and in contact with the liquid, was colored a dark blue in each instance, showing that the absorption, by direct contact with the solution, was practically the same. Keen and Rosenberger⁶ have investigated the absorptive powers of the Pagenstecher thread and compared it with twisted and braided silk. They made no mention of the capillary properties of these materials, but did find that the increase in weight from the absorption of fluid was 41 per cent. in the Pagenstecher, 42.9 per cent. in the braided, and 22.2 per cent. in the twisted silk. In Pagenstecher's original article capillarity is not considered.

EXPERIMENT 2.—This was similar to the first, except that the sutures, the catguts being omitted, were first boiled, then tied around the frame, and placed in the colored solution while still wet, in the same condition as when they are used clinically. From this experiment it was noted that the sutures have a greater degree of capillarity when wet than when dry (Fig. 2). The result was the same after boiling in plain water, or in the usual 10 per cent. solution of sodium carbonate.

The extent of the capillarity will be found to be dependent on various conditions other than the presence or absence of moisture. For example:

EXPERIMENT 3.—Tensity: (Fig. 3, A.) thread 1 is taut and 2 is lax, the capillarity is more marked in the one that is loose.

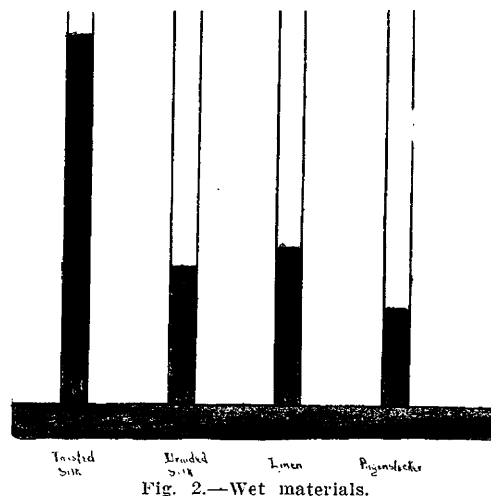


Fig. 2.—Wet materials.

EXPERIMENT 4.—The influence of the knot (Fig. 3, B.). In thread 1 the knot receives no consideration, thread 2 has the end tied in a square knot, and there is a knot in the continuity of thread 3, from which it is evident that the knot exerts an inhibitory influence on capillarity.

EXPERIMENT 5.—The size of the thread (Fig. 3, C.). Thread 1 is of large coarse twisted silk, thread 2 is small fine twisted silk. There is a greater degree of capillarity in the larger thread.

EXPERIMENT 6.—Contact: Figure 3, D., shows the greater capillarity when thread 1 is in contact with a flat surface and thread 2 is not.

The different degrees of capillary action in twisted and braided silk and other usual suture materials have been shown in the preceding diagrams.

EXPERIMENT 7.—In an attempt to approach more closely to the clinical conditions sutures were boiled, after which some were passed through the serous and muscular coats of a dog's intestine and others through the same coats of a pathologic human appendix, immediately after its removal, not entering

4. V. Chlumsky: "Experimentelle Untersuchungen über die verschiedenen Methoden der Darmvereingung," *Beit. zur klin. Chir.*, Dec., 1889, vol. xxv, iii.

5. J. S. Horsley: "A Contribution to the Study of Intestinal Suture," *Annals of Surgery*, November, 1903.

6. Keen and Rosenberger: "The Surgical Use of Celluloid Thread," *Phil. Med. Jour.*, March 10, 1900.

7. Pagenstecher: "Celluloidzwirn, ein neues Naht und unterbindungsmaterial," *Deut. med. Wochft.*, April 6, 1899.

the lumen in either case. The sutures were then tied around the frame and placed in the colored solution. The result was not different from that attained after simple boiling.

EXPERIMENT 8.—In this instance sutures were made to enter into the lumen of the animal's intestine and others into that of the appendix; they were made to pass along the lumen and then were brought out through the wall. The result showed a striking diminution in the capillary action (Fig. 4).

EXPERIMENT 9.—In order to eliminate the factor of the drying or evaporation of moisture from the threads beyond the colored fluid, intestinal contents were placed in a shallow receptacle, in the center of which a drop of concentrated solution of methyl blue was added. Diffusion between these liquids was very slow and limited. Twisted silk, as it had been shown to be the most capillary, was placed so that part of the silk was in the blue fluid and the distal or peripheral portion in the intestinal contents. The blue color did not travel along the suture material, there was an absence of capillarity (Fig. 5, A). In a control, no intestinal contents being used, the capillarity was very marked (Fig. 5, B).

The animal experiments were made on dogs and cats at the Denver and Rio Grande R. R. Hospital, with the assistance of Drs. Slopanskey and Titus.

EXPERIMENT 10.—The animal was anesthetized, the abdomen opened, and a loop of small bowel brought into the wound. Rubber constrictors were placed around the gut about 4 inches

contents, which apparently had acted as a preventive to capillarity. Part 3 had been in contact with neither the mucosa nor the intestinal contents, yet, in the absence of capillarity it was similar to Part 1. A possible explanation is that the mucous contact, at the point where Parts 2 and 3 join, where the suture passes through the gut wall, was sufficient to prevent the outward extension of capillary action, and so to account for the absence of the blue color in the suture external to the point of contact with the mucosa.

EXPERIMENT 11.—This was similar to No. 10, with the exception that, after the injection of the methyl blue and the closure of the puncture wound, the loop with the constrictors was replaced within the peritoneal cavity and left there for 15 minutes. After this time it was carefully removed and examined, but there was no color in the ends of the thread on the serosa. On opening the gut, part two of the suture within the lumen was found deeply stained.

EXPERIMENT 12.—This differed from No. 11 in that the gut, with the suture in its wall, the colored solution in its lumen, and the constrictors, was left in the peritoneal cavity for 45 minutes. The result was the same as in No. 11.

EXPERIMENTS 13 and 14.—These were similar to No. 12, except that braided silk was used in one and Pagenstecher thread in the other. The results were identical with those in Nos. 11 and 12.

EXPERIMENT 15.—A twisted silk suture was placed in a loop of bowel, as in the previous experiments, but instead of using rubber constrictors, because of a possible alteration from the clinical conditions, the bowel was compressed by the fingers of an assistant and the solution was then injected. After keeping the colored solution in contact with Part 2 of the suture for a few minutes the digital compression was relieved and the loop of bowel, with the suture and colored fluid, was replaced within the peritoneal cavity and allowed to remain there for 35 minutes. After this time it was removed; there was no evidence of blue in Parts 1 or 3 of the stitch. On opening the gut Part 2 on the mucosa was found to be a deep blue in color.

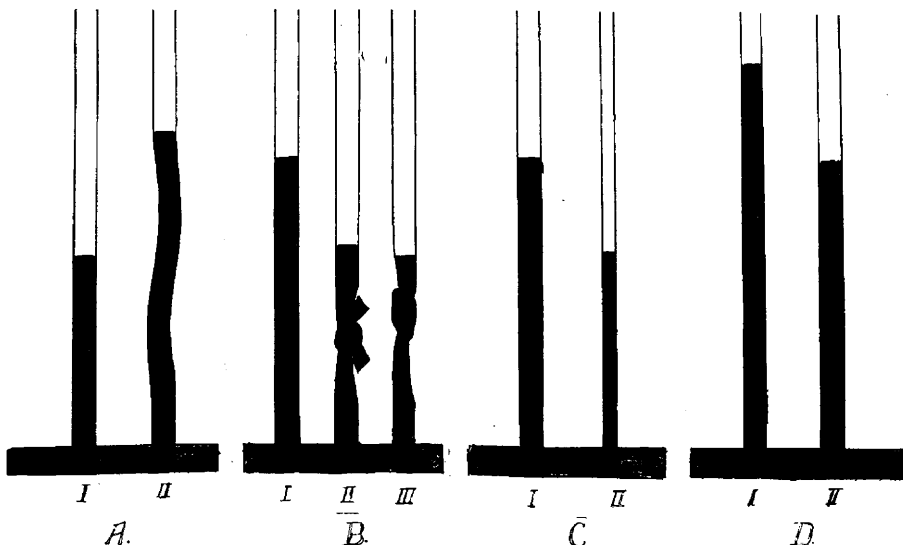


Fig. 3.—Showing: A, difference in taut and lax threads; B, influence of the knot; C, capillarity of finely and coarsely twisted silk; D, capillarity when the thread is in contact with a flat surface and when it is not.

apart. In the center of this loop a suture of boiled twisted silk was inserted, from the serosa through all layers of the wall into the lumen, then for about an inch along the lumen parallel to the long axis of the bowel, and finally passed through the wall to terminate on the serosa. The two ends were left half an inch long and were not tied. A solution of methyl blue was then injected into the lumen, between the constrictors; sufficient fluid was injected to enable its presence to be demonstrated, but not sufficient to distend the gut (Fig. 6.).

The ends of the suture, on the serosa, were watched for fifteen minutes and there was no appearance of color in either end. Subsequent opening of the bowel showed that portion of the suture in the lumen to be stained a deep blue. Figure 6 shows the suture that was inserted in Experiment 10. It may, for convenience, be divided into parts 1, 2 and 3. Part 1 has passed through the wall into the lumen and out through the wall again. Part 2 has passed into the lumen and remains there. Part 3 has not entered the bowel lumen. Part 2 was in direct contact with the blue in the lumen and absorbed the color. Parts 1 and 3 did not receive any of the coloring, by capillarity or otherwise. Part 1 had passed through the bowel wall and the lumen and been in contact with the mucosa and the intestinal

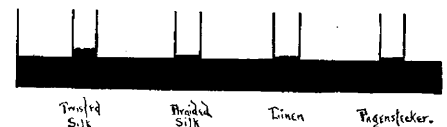


Fig. 4.—Diminution in capillary action in the intestinal contents.

EXPERIMENT 16.—This was the same as No. 15, with the exception that the two ends of the suture on the serosa were tied. The result was not different from that obtained in the other experiments.

EXPERIMENT 17.—This was undertaken with the object of determining the difference, if any, as regards capillarity, between the bacteria of the intestinal lumen and the colored solution that had been injected in the previous experiments.

Under strict aseptic technic the skin and superficial fascia of abdomen were incised and reflected, the aponeurosis and muscles were seared with the actual cautery, and the abdomen was opened. A part of the large bowel was brought into the wound, and an eight-inch forceps was introduced into the rectum by an assistant, the tip of which was made to present in the bowel at the abdominal wound. A threaded needle was inserted through the intestinal wall from the serosa, into the lumen, where it was grasped by the forceps and drawn down for a few inches. The forceps was removed, allowing the needle and thread to remain in the cavity of the large bowel. The serous end of the thread was cut about half an inch from where it entered the intestine. The viscera were replaced within the abdomen and the wound closed with temporary sutures. The animal was kept under the anesthetic for an hour, the ab-

domen was then reopened, the intestine with the perforating suture was carefully brought into the wound, the suture cut off close to the intestine, and dropped into a tube of culture media. The result was negative (Fig. 7.).

As a control, after the previous described steps were taken, a suture was passed into the lumen and out again. A piece of the suture material that had passed through the lumen was dropped into a similar tube of culture media. The result was positive.

EXPERIMENT 18.—This was similar to No. 17, with the exception that the animal was kept under the anesthetic for 2 hours after the insertion and before the removal of the stitch. The result was negative.

In the experiments, the time allowed for the capillarity to manifest itself did not exceed two hours, because of the clinical fact that within this time the serous plastic exudate will have been thrown out between the

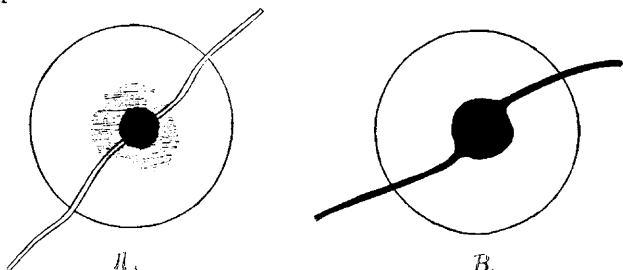


Fig. 5.—A, Lack of capillarity in intestinal contents; B, marked capillarity without intestinal contents.

apposed serous surfaces, and after that time the suture material has been excluded from the general peritoneal cavity.

From the preceding it would seem that the danger of peritoneal infection by capillarity in intestinal suturing has been greatly exaggerated and that it has little substantial basis. This is also emphasized by recent clinical experience in which intentional or unintentional perforating sutures have been used with practically uniform success.

That the fear of capillarity is decreasing is shown by the many modern methods of enterorrhaphy and anastomosis in which through-and-through sutures have been employed. Such as the methods of Bishop,⁸ Vesein,⁹

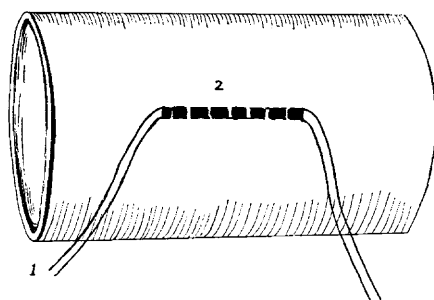


Fig. 6.—Suture in intestine.

Maunsell,¹⁰ M. E. Connell,¹¹ Wiggin,¹² Cheate,¹³ Hartigan,¹⁴ Horsley⁵ and others and the method which I¹⁵ had the honor of demonstrating before this Session in 1901 at the St. Paul

text-books by authors at home and abroad in which sutures of this variety are described and approved.

In the two-row methods of suturing the Czerny suture has been improved so that it is now made to include the entire thickness of the wall instead of but part of it. Albert,¹⁷ the first so to modify it, placed the knots on the serosa, and Mikulicz⁴ later located the knot within the lumen.

In the mechanical contrivances and aids in gastro-intestinal surgery, the through-and-through suture has had its place. Threads were passed directly from the lumen through the openings in the gut walls by M. E. Connell in the original "plate operation." Senn subsequently placed needles on these threads and passed them through the intestinal wall. The puckering string of the Murphy button perforates all layers of the viscera, and the "elastic ligature" passes through all coats into the lumen and out again.

In the face of the above short review of the history, clinical experience and experiments, it would seem that capillarity should no longer be considered as an objection to the through-and-through stitch. By employing a square or right-angled, instead of a round or whip, stitch (Fig. 7), the extent of the suture material on the serosa may be reduced to a minimum, and that little may be separated from the general peritoneal cavity by serous apposition.

Because of its bulk, the knot will be isolated in this manner with more difficulty than is the rest of the suture. But success has followed the leaving of the knot of deliberate through-and-through stitches on the serosa without further attention. It has

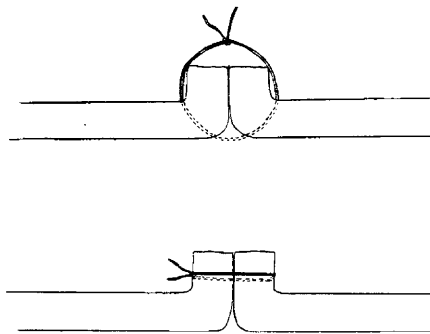


Fig. 7.—Showing suture inserted in bowel.

been left that way in a necessarily large percentage of stitches that attempt to penetrate but not to perforate the submucosa, as is well shown in the recent report of Eggers and Maury.¹⁸

It may be covered by a sero-muscular stitch, i. e., one not attempting to include part of the submucous layer. Or best, from a theoretic standpoint, the practicability of which has been demonstrated, the knot may be placed outside of the peritoneal cavity, within the lumen.

17. Albert: Wien. med. Press, 1881.

18. Eggers and Maury: "What Becomes of Lembert Stitches Placed in the Gut?" Surg., Gyn. and Obst., May, 1906.

Dangers of Unregulated Gymnastics.—A system of gymnastic exercises without apparatus was promulgated a few years ago by J. P. Mueller. His latest book, entitled "My System," was mentioned recently in THE JOURNAL, on page 626. Our German and Swiss exchanges have lately contained several communications from physicians relating serious damage from the use of these exercises by persons predisposed to or already affected with unsuspected organic affections. They warn against this "Muelleromania," as they call it, urging the necessity for medical individualization of strenuous exercising for persons past the prime of life or debilitated from any cause. One physician says that he has known several examples of heart disease unmistakably acquired by this means.

8. E. S. Bishop: "Enterorrhaphy," Med. Chron., Sept., 1885.

9. Vesein: "La Suture Intestinale," Bul. Soc. de Chir., 1871.

10. H. W. Maunsell: "A New Method of Intestinal Surgery," Amer. Jour. Med. Science, March, 1892.

11. M. E. Connell: "Intestinal Anastomosis," THE JOURNAL A. M. A., July 29, 1893; Med. Rec., Sept. 17, 1892.

12. F. H. Wiggin: Med. Rec., Nov. 19, 1898.

13. G. L. Cheate: "A Method of Uniting the Divided Intestine," Lancet, 1897, vol. i and vol. ii.

14. J. W. Hartigan: "A New Method of Intestinal Anastomosis," New York Med. Jour., July 17, 1897.

15. F. G. Connell: "The Knot Within the Lumen in Intestinal Surgery," THE JOURNAL A. M. A., Oct. 12, 1901.

16. F. G. Connell: "Intestinal Sutures," Phil. Med. Monthly, Jan. 1899.