

Puncture of the abdominal cavity with the hope of obtaining fluid for diagnostic purposes is never to be advised unless laparotomy is at once to be performed. This is especially true of puncture of the gall-bladder, since even the finest needle makes a hole from which bile continues to be discharged for a long time.

Intestinal puncture should be made in the linea alba when possible because in this line one is certain not to wound any large vessel. There must, of course, be tympanic resonance at the point selected for puncture. A sharp hollow needle not attached to a syringe is thrust in at right angles to the surface of the abdomen until gas is heard to escape through it. If the lumen of the needle is stopped by some of the tissues through which it passes, or by feces, the syringe should be attached and gentle aspiration made. When the tension of the abdomen is relieved, the gas escaping more slowly makes no sound, but its presence can be shown by its effect upon the flame of a match or by letting a drop or two of fluid fall upon the outer end of the needle. Usually, too, the gas which escapes has a penetrating odor. The needle should remain in position from fifteen minutes to an hour if the escape of gas continues so long. It is then withdrawn by a quick motion. If the meteorism recurs and a second puncture is required, the needle should be introduced at some other point.

**Enterorrhaphy, Enterotomy, Enteroplasty, Enteropexy.**—These operations upon the intestine are similar to those performed upon the stomach, and the technic is similar. In order to avoid narrowing the lumen of the intestine all sutures should be made transverse. Even longitudinal wounds should be sewed transversely. The intestinal wall is so flexible that this method of suture is easily carried out and a slight increase in the lumen of the intestine is no disadvantage. In the course of time such a dilatation entirely disappears.

Enteroplasty, which is analogous to pyloroplasty, is called for in the case of cicatricial and other benign stenoses of the intestine and to overcome the effects of a spur or valve. Other more complicated methods are usually employed in the closure of an artificial anus associated with a spur. These will be described later.

Enteropexy or colopexy is an operation sometimes performed for the relief of chronic prolapsed rectum. The sigmoid flexure is affixed to the wall of the pelvis or of the abdomen by a series of sutures.

An enteropexy may be performed in connection with other operations in order to lessen the mobility of the intestine. Thus the sigmoid colon has often been sutured to the abdominal wall in order to prevent a recurring volvulus. Enteropexy may also be employed to prevent a chronic intestinal invagination, especially in children.

**Enterostomy.**—Enterostomy, or the establishment of a permanent external opening in the intestine, may be performed for either of two objects: for the sake of artificial feeding or for the discharge of intestinal contents. An opening for the first of these two purposes will naturally be made as high up in the intestine as possible (duodenostomy or jejunostomy), while one for the discharge of feces will be made as

low down as possible (ileostomy, colostomy). The difference in purpose has led also to a difference in technic.

**Duodenostomy; Jejunostomy.**—On account of the anatomical relations only the first portion of the duodenum can be utilized for a permanent fistula, and a high jejunostomy is generally preferable. This may be performed according to the principles of gastrostomy, Witzel's method being the best. (Page 416.) The drainage-tube is placed longitudinally in the efferent portion of the intestinal loop and two longitudinal folds of intestine are sutured over it. If the fistula is only a temporary one, the operator should avoid too great a narrowing of the bowel at this point. Even when the fistula is to be permanent it is necessary to leave sufficient room for the passage along the side of the drainage-tube into the lower bowel of bile, pancreatic juice, and other secretion. The tube therefore must be a slender one, not more than 4 or 5 mm. (0.2 inch) in diameter, and the intestinal folds which are sewed over it should not be too broad.

If jejunostomy is performed simply as a palliative operation when the patient is unable to endure resection of the stomach or gastro-enterostomy or gastrostomy, a median incision in the neighborhood of the umbilicus will suffice; otherwise an incision through the left rectus muscle is preferable.

Maydl is an enthusiastic advocate of jejunostomy, which he performs as follows: Through an incision in the median line below the umbilicus he reaches the highest loop of the jejunum, divides it transversely 20 cm. (8 inches) below the duodenum and implants the upper end in the side of the lower from 20 to 30 cm. (8 to 12 inches) below the point of incision. This anastomosis is made either with suture or with a Murphy button. The cut end of the efferent bowel is freed from its mesentery for a distance of 2 cm. (0.8 inch), passed beneath the skin, or the skin and rectus muscle, and brought out of the second incision through the skin at a distance of 2 cm. (0.8 inch) from the first incision. It is fixed to the skin by a few stitches and the original abdominal incision is completely closed. Albert performs the same operation, except that he makes a lateral anastomosis between the afferent and efferent portions of the jejunal loop and brings the loop itself out under the bridge of skin and rectus muscle and opens it at the end of four days, or sooner if necessary. Mikulicz holds a less favorable opinion of jejunostomy, and performs it only under circumstances in which gastro-enterostomy is impossible or unsatisfactory.

Temporary jejunostomy may be necessary in the case of severe burns of the œsophagus or stomach, or severe hemorrhage of the stomach which cannot be otherwise controlled, and also in case of cicatricial stenosis of the pylorus when the condition of the stomach is such that neither gastro-enterostomy or pyloroplasty is possible, and finally in cases of gastric ulcer so severe that absolute rest of the stomach is necessary to effect a cure.

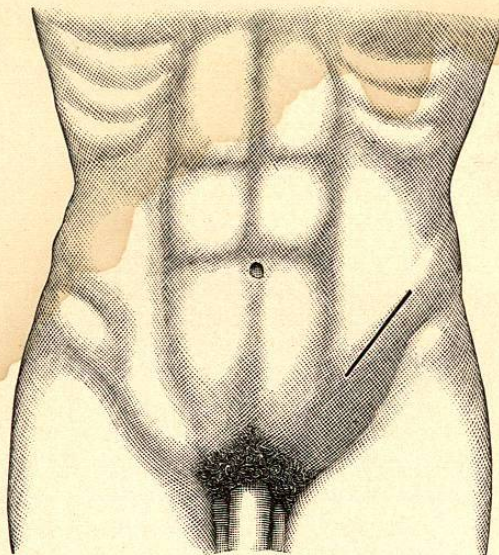
If the wall of the stomach is found at operation to be so extensively infiltrated with cancer that a gastro-enterostomy is impossible, it is



better simply to close the abdominal cavity rather than to establish an intestinal fistula in the hope of prolonging the patient's life for a few weeks. This condition is by no means comparable to carcinoma of the oesophagus, which can successfully be met by a gastrostomy. Such a patient has usually little or no pain except when he attempts to swallow, and he enjoys a fair degree of health for some months after gastrostomy, while a patient with extensive carcinoma of the stomach suffers from almost continuous pain irrespective of his lack of nutrition, and his cachexia cannot be overcome by any artificial means of introducing nourishment.

There is, too, a great difference between artificial feeding through a fistula of the stomach and that through an intestinal fistula. In the first case, gastric digestion is more or less preserved and the physiologic

FIG. 197.



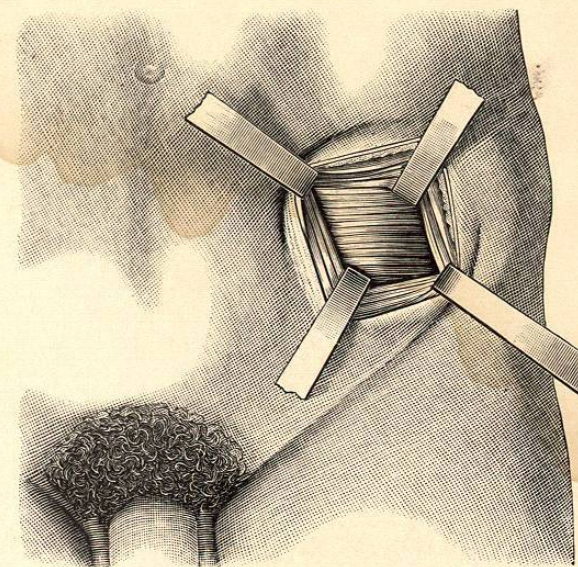
Incision for inguinal colostomy. (Hartmann.)

relations between the gastric juice on the one hand, and bile, pancreatic juice, and intestinal juice on the other, enable the patient to get the good of his food. Furthermore, the stomach acts as a reservoir for the food so that nutrition can be provided for with a limited number of meals. All these conditions are changed in jejunostomy, and it is found to be extremely difficult to maintain the health of the patient through a jejunal fistula. This difficulty is much increased by the presence of a carcinomatous stomach. It is therefore not surprising that jejunostomy is less satisfactory than gastro-enterostomy under similar conditions.

**Ileostomy; Colostomy.**—Ileostomy is performed only when the obstruction to the fecal stream exists in the cæcum or above it. There

are two forms of fecal fistula. There is a fecal fistula, in the narrower sense of the word, from which escapes only a portion of the intestinal contents, while the rest passes by the natural channels. Then there is a fecal fistula that is called an artificial anus, through which the whole fecal discharge reaches the outer world. There are all degrees between the smallest fistula and an artificial anus. A lateral fistula is established with the object of relieving the intestine; an axial fistula, if it is desired to keep the lower portion of the intestine entirely free from fecal matter, or if the fistula is to remain throughout life.

FIG. 198.



Inguinal colostomy. Separation of muscular fibres. (Hartmann.)

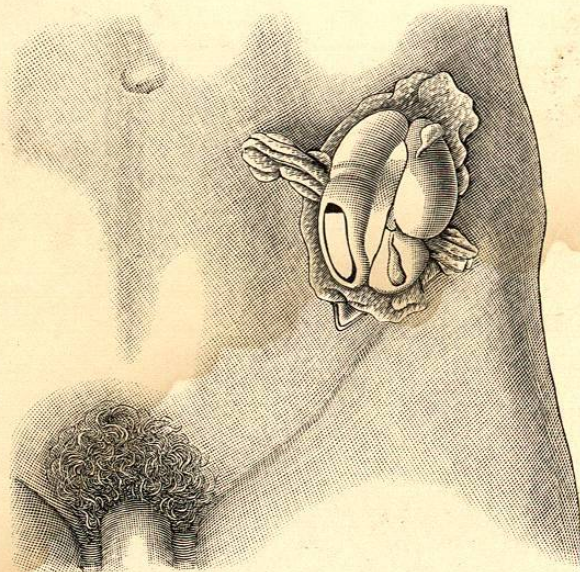
For the sake of cleanliness it is well to place the fistula in the lower portion of the abdomen not far from the inguinal fold. (Figs. 197–199.) The rest of the surface of the abdomen is thus kept free from defilement with feces, and it is easier for the patient to look after the fistula than when it is situated elsewhere. Furthermore, apparatus having for its object the retention of feces works more satisfactorily in this region.

In general there are two portions of the intestine suitable for the establishment of a fecal fistula, namely, the region of the ileocæcal valve for obstruction existing anywhere in the large intestine, with the exception of the sigmoid colon and rectum, and the region of the sigmoid for obstruction existing in the sigmoid or rectum. In the first case the fistula will be established either in the cæcum or in the adjacent portion of the ileum. In the second case it will be situated in the sigmoid or in the lowest portion of the descending colon. In a few cases a fistula is made in some other situation; for example, if the



abdomen is opened low down in the median line, and for some reason it is desired to use the portion of intestine which presents itself in the wound. Only the lowest portion of the ileum should be utilized for a fecal fistula, since the risk of death by starvation is greatly increased if the fistula is only a short distance removed from the ileocaecal valve. (See section on Intestinal Fistula, page 281.)

FIG. 199.



Inguinal colostomy. Completion of operation. (Hartmann.)

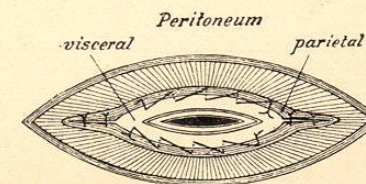
**Establishment of a Fecal Fistula.**—An incision 5 to 10 cm. (2 to 4 inches) long is made parallel to Poupart's ligament, and 3 to 4 cm (1.2 to 1.6 inches) above and in front of the anterior superior spine. As soon as the peritoneal cavity is opened, the portion of intestine in which the fistula is to be made is brought out of the wound.

If meteorism is marked, as so often happens in these cases, it may be difficult to find a proper intestinal coil because the much dilated coils of small intestine crowd into the wound. The determination of the proper coil usually rests upon the recognition of large intestine. The thick longitudinal bands which normally distinguish large intestine may be obscured by congestion and dilatation. Under such circumstances the appendicæ epiploicæ are the best distinguishing marks. Another sign characteristic of the large intestine is the direction of its meson. One should not trust to the length of the meson, since the sigmoid mesocolon may be very long. But the mesons of the ascending and descending and sigmoid portions of the colon, all spring from the lateral walls of the abdomen, a fact which can always be readily determined by the examining finger. The mesentery, on the other hand, springs from the spinal column high up. If a loop of ileum is

to be used for the fistula, it should be chosen by estimating the distance from the cæcum.

The opening in the intestine should be made opposite to the mesenteric attachment. The intestine is fixed in the wound by a continuous serous suture of the visceral peritoneum to the parietal peritoneum and transversalis fascia. The space thus surrounded by suture should

FIG. 200.

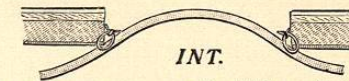


Showing the establishment of a fecal fistula.

measure 3 to 4 cm. (1.2 to 1.6 inches) in length and 1.5 to 2 cm. (0.6 to 0.8 inch) in breadth. If the wound in the parietal peritoneum is longer than this, it should be reduced in size by a couple of interrupted sutures. (Figs. 200-202.)

If there is no need to hasten the opening of the bowel, this step in the operation is postponed for one or two days, less for the protection

FIG. 201.



Artificial anus. Suture of bowel to peritoneum by stitches which do not perforate the lumen of the bowel. (Hartmann.)

of the peritoneal cavity, which is already protected by suture, than for the protection of the abdominal wound from the contents of the intestine, which often possess a high degree of virulence. A patient may die as a result of infection extending between the layers of the abdominal wall, without the development of peritonitis. The reaction which

FIG. 202.



Suture of bowel to skin by stitches which perforate all of the coats of the bowel. (Hartmann.)

takes place in a wound within two days will sufficiently protect the surrounding tissues from infection.

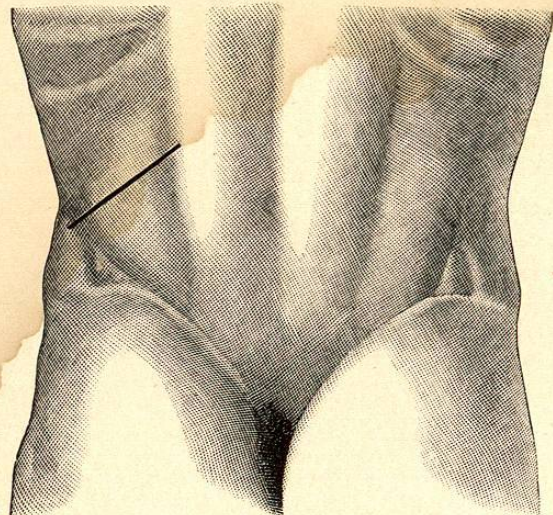
In operating in two steps it is well to use interrupted serous sutures, and to leave the ends long, covering the bowel with a bit of iodoform gauze. If this is done, the surgeon will have no difficulty in ligating the bowel even though after this lapse of time it closely resembles the rest of the wound in appearance. The bowel may be



opened with a scalpel or a thermocautery. The incision should be considerably shorter than the wound in the peritoneum. If the operation is completed at once, the mucous membrane of the bowel is brought outward and stitched to the skin in order to protect still further the abdominal wound from infection. But as this protection is not absolute, it is well to leave two little gaps at the angles of the wound through which iodoform drains may be inserted.

During convalescence the fistula in the intestine may grow much smaller on account of cicatricial contraction. Such a fistula may be dilated by the introduction of increasingly larger rubber tubes; or, if this treatment fails, the incision may be prolonged from 0.5 to 1 cm. (0.2 to 0.4 inch) at either end in the direction of the lumen of the bowel. The partially cut mucous membrane is to be brought outward

FIG. 203.



Incision for lumbar colostomy. (Hartmann.)

and stitched to the skin. The care of a fecal fistula after the wound is completely healed is spoken of below. A lumbar colostomy is not so conveniently situated as an inguinal one. (Fig. 203.)

**Establishment of an Artificial Anus.**—If there is some complete obstruction below the fecal fistula, the latter acts necessarily as an artificial anus and discharges all of the intestinal contents; but if such a complete obstruction does not exist below, a portion of the fecal stream will pass by, and may produce pain, ulceration, obstruction, and dilatation below the fecal fistula. In general a fecal fistula tends to change into an artificial anus by the formation of a broad spur between the afferent and efferent portions of the intestine. If it is known at the time of operation that the whole fecal stream must permanently pass from the fistula, it is better to cut off the efferent bowel

so as to prevent any possibility of fecal matter passing through it. (Fig. 204.) This operation as performed by Maydl is carried out in two steps. The abdominal incision is made and the coil of intestine selected and brought out of the wound sufficiently far to permit the passage through its mesentery of a strip of iodoform gauze. The ends of the gauze rest upon the abdominal wall and keep the intestinal coil in position. (Fig. 205.) Both the afferent and efferent portions of the intestinal loop are stitched to the peritoneum. If the operation is to be completed at once, this suture should be carefully carried out; whereas if the bowel is not to be opened for one or more days, a few interrupted

FIG. 204.



Artificial anus. Immediate opening of bowel. (Hartmann.)

stitches are sufficient. The bowel is opened transversely through half of its circumference with a knife or Paquelin cautery. This opening suffices to permit the escape of intestinal contents, and a week later when granulations are well formed the rest of the intestine is divided and the iodoform gauze removed. As both ends of the intestine have a tendency to retract, they must be sutured to the skin with silver or aluminum bronze wire.

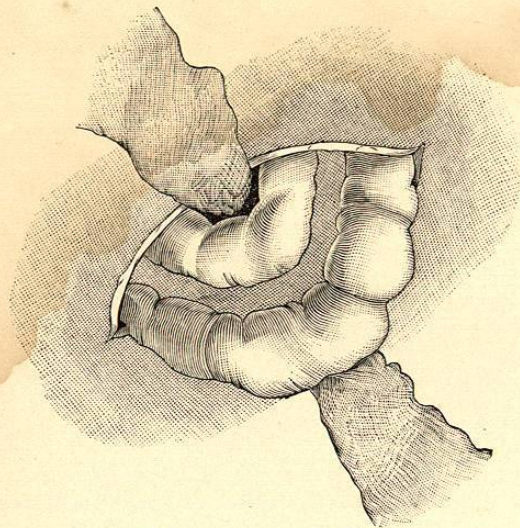
Schinzinger operates as follows: The intestinal coil is completely



divided at first, the efferent portion is sutured blindly and dropped back, and the afferent portion is stitched in the abdominal wound. This method is not to be followed unless the obstruction below will permit the passage of the secretion of the intestine itself. This operation eliminates entirely the lower portion of the bowel, the advantages and disadvantages of which are spoken of elsewhere.

Some surgeons attempt to make a special valve in the artificial anus. Gersuny recommends that the intestine be twisted for 180 or 270 degrees. Witzel draws the bowel through a slit in the gluteus maximus, or seeks to form an anus from the rectus muscle by splitting it into an anterior and a posterior half and bringing the intestine out between them. Gleich bores a hole through the iliac bone 3 or 4 cm. (1.2 to 1.6 inches) below its crest and brings the intestine out through it.

FIG. 205.



Establishment of an artificial anus.

These and similar attempts to make an artificial sphincter are almost invariably disappointing. An essential feature of the normal sphincter is its reflex action, and this, of course, must be wanting in any artificial anus. Furthermore, the annoyance to the patient of a simple artificial anus properly placed is not so very great. After a certain time the bowel evacuates its contents with considerable regularity, especially if the patient is careful what he eats; so that when no diarrhoea exists such a patient has one or two movements a day and nothing comes from the fistula between times. The need for an evacuation makes itself known much as it does when the feces pass from a normal rectum, provided, of course, that the fistula is situated in the large intestine. The nearer it lies to the rectum, the better as a rule is its action

When the wound is healed and the patient is out of bed, he wears an apparatus somewhat like a truss, which is only removed for defecation. The pad consists of an oval plate and a soft rubber ring filled with air or glycerin which surrounds the fistula. In this manner pressure is made upon the skin, and not upon the fistula itself. A small bit of gauze is worn between the pad and the opening in the bowel. If such an apparatus causes the patient discomfort, a special form of bandage may be constructed.

**Closure of a Fecal Fistula.**—This operation will be described without reference to the existence of any complicating disease, tumor, tuberculosis, etc. The anatomical and pathological peculiarities of such conditions are discussed in the sections on Diseases of the Intestine.

Small fistulas existing without a valve and which are not lined with a mucous membrane frequently close spontaneously. If they are lined with epithelium, they will often close after the epithelium has been destroyed by some caustic or the thermo-cautery. If the fistula is larger, say as large as a small lead pencil, and leads directly into the intestine, it may often be closed by a simple suture made around it just far enough away to include the whole scar. This cut extends into the bowel and after removal of the fistula the wound in the bowel is sutured with catgut. Parallel to the wound in the skin and 4 or 5 cm. (1.6 or 2 inches) away from it a crescentic incision is made, the skin and subcutaneous fat are lifted from the underlying fascia, and this bridge of skin is utilized to cover the previous

FIG. 206.

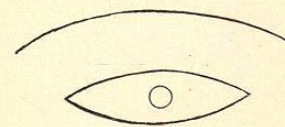


FIG. 207.



Dieffenbach's method of closing a fecal fistula.

site of the fistula. The second wound is allowed to heal by granulations. (Figs. 206 and 207.)

If the simple operation just described fails to close the fistula, or if the size of the fistula is such that it is useless to try to close it by this method, the intestinal coil involved should be loosened from the abdominal wall, the fistula resected, and the wound in the intestine closed by direct suture. This operation was previously greatly feared on account of the risk of peritonitis. This risk is to-day a slight one provided the intestine is healthy and there is no complicating suppuration in the neighborhood. In order to secure a certain result it is necessary to separate the intestine from the anterior abdominal wall to such an extent that normal portions of intestine can be sutured without tension. Furthermore, it is essential to obtain primary union of the intestine if one would avoid risk and have a perfect result. The incision is made through the skin from 3 to 5 mm. (0.1 to 0.2 inch)



away from the border of the fistula, and when the superficial tissues have been divided the incision is continued until the peritoneal cavity is opened. The operator may find it of advantage to pass into the lumen of the bowel a finger protected by a rubber cot or a glove in order not to wound it. As soon as the peritoneal cavity has been opened the forefinger is passed into it and the dissection continued until the intestine containing the fistula is entirely free. In the neighborhood of such a fistula there will always be found adhesions between different portions of intestine or omentum or parietal peritoneum. These should be divided in as far as they interfere with the proper suture of the intestine, otherwise they should be left alone, since they afford some protection to the rest of the peritoneal cavity and fix the sutured intestinal coil in the neighborhood of the abdominal wound. Hasty separation of adhesions may easily lead to accidental tearing or cutting of some portion of the intestine.

This separation of the affected intestine is the most difficult part of the operation. When it is completed, the edges of the fistula in the intestine are freshened and cut away until the thread can be passed through the normal intestinal wall. In doubtful cases it is better to remove too much than too little. The edges of this intestinal wound are to be united transversely by two rows of sutures, and the wound in the abdominal wall should be partially closed with doubly placed silver or bronze wire stitches. A gap should be left through which a short strip of iodoform gauze may extend to the sutured portion of intestine. This serves as a safety-valve in case the suture in the intestine does not hold, and protects the general peritoneal cavity from infection. In four or five days the iodoform gauze can be changed for a small, short drainage-tube which should be left in place for a few days longer.

The length of the intestinal sutures in this operation depends upon the size of the defect in the intestine. If a great deal of tissue has to be cut away, the intestinal suture is similar to the suture after a circular resection of the intestine.

An artificial anus may be closed in a number of ways. Dupuytren's method, which was the only one practised in pre-antiseptic times, rests on the principle of changing an artificial anus into a fecal fistula and then closing this in the manner above described. The first step in this method is to overcome the spur—that is, the partition between the afferent and efferent portions of the bowel. Dupuytren used an instrument like a pair of shears whose blunt blades are provided with shallow ridges each fitted into one another. One of these blades was introduced into each portion of the bowel and the intervening spur was compressed by means of a screw in the handle. This screw was tightened a little each day until the spur was cut through in about a week. As the spur was thus gradually destroyed by pressure the opposing serous surfaces united by traumatic adhesion in case they had not previously done so. In this manner opening the peritoneal cavity was avoided and the patient was protected from peri-

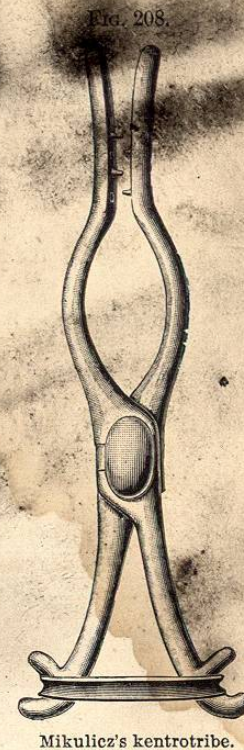
tonitis. Numerous defects showed themselves in the use of this instrument, which has been variously modified, but is rarely used at the present time.

Mikulicz has also devised an instrument to crush a spur, which is shown in Fig. 208, which he calls the kentrotroibe. Pressure is obtained by means of an elastic band placed around the handle. This gives a more gradual pressure than a screw is capable of doing.

Krause has a clamp which makes a pressure in the deepest part of the spur so as to produce anastomosis between the afferent and efferent loop. When such an opening is well established, he sutures blindly the external openings of the intestine.

One should judge by digital examination when the spur is sufficiently divided. When such is the case, at least a part of the feces will pass by the natural channel. The artificial anus may then be closed by one of the methods described above. The best plan on account of the size of the fistula is to free the intestine from the abdominal wall, freshen the edges of the fistula, and close the wound by direct suture.

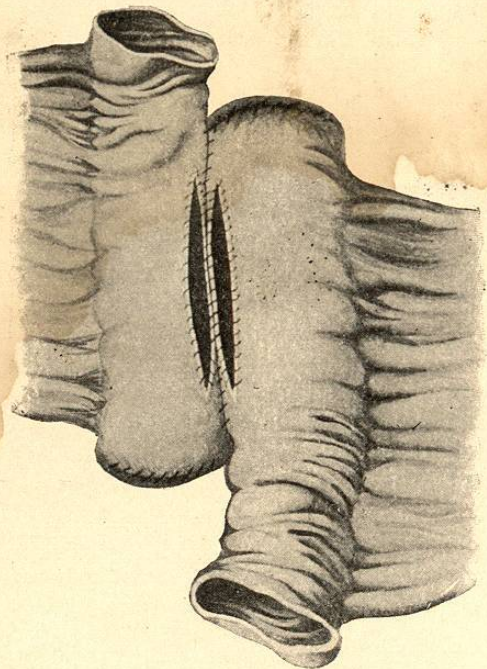
The portion of the intestine containing the artificial anus may be resected and its contents united by a circular suture. This operation, which was first performed by Billroth, requires a wide opening of the peritoneal cavity and a free separation of the affected portion of the intestine. It should be carried out according to the principles of a careful laparotomy. The abdominal incision and separation of the intestine are made according to the rules given for direct suture to close an intestinal fistula. There is nothing peculiar about the circular suture except that the stitches should everywhere pass through healthy intestine. As long as the peritoneal cavity is to be freely open, it makes no special difference whether a few centimetres of intestine more or less are resected, and the success of the operation depends upon the ability of the operator to oppose practically normal serous surfaces by his suture. The opening in the abdominal wall made by cutting around the fistula will not be sufficient for the operation. It will be either necessary to extend the wound in one or both directions, or else to make a second wound near the fistula through which one can open the peritoneal cavity and loosen the affected intestine without risk of soiling the peritoneum. The greatest advantage of resection with circular suture is the promptness with which the patient is cured of his trouble.





A further advantage is the freedom from subsequent stenosis, kinking, etc. The risk of the operation is the only disadvantage. It may be followed by post-operative peritonitis due to infection at the time of operation, or to subsequent infection from an imperfect suture. With the present methods of operating the risk of infection at the time of operation is slight provided there is no suppuration in connection with a fistula. Temporary tamponade protects the general peritoneal cavity during the manipulation of the intestine. The proper closure of a wound can be secured by the introduction of a small iodoform gauze tampon. Secondary infection of the peritoneum from an

FIG. 209.



Resection of intestine with lateral anastomosis. Posterior suture inserted. The free ends of the bowel inverted and sutured. (Richardson.)

imperfect suture is somewhat difficult to avoid as the sutured intestine lies free in the abdominal cavity, and infection due to a leaky suture will easily produce a general peritonitis, whereas in case of the operations performed in two or more steps the general peritoneal cavity is more or less protected by adhesions. As previously emphasized, there is a great difference between suture of the small and suture of the large intestine. For the reasons mentioned suture of the small intestine is more certain, while risk of infection during operation upon the small intestine is much less because its bacteria are fewer in number and possess less virulence.

The operator will be guided by circumstances in his choice of methods. Indeed, the different methods may frequently be combined with advantage. Thus in place of a circular resection with suture one may perform lateral anastomosis and close both intestinal ends blindly. (Figs. 209 and 210.) If the small intestine has to be united with large intestine or if the lumina of the two portions of the intestine vary greatly, a lateral implantation is preferable. If the artificial anus is in the small intestine, the best operation is usually resection with circular

FIG. 210.



Lateral anastomosis completed by Lembert continuous suture. (Richardson.)

suture, or lateral apposition, or implantation, the operation being performed after free opening of the peritoneal cavity. If the opening is in the large intestine, Mikulicz prefers to divide the spur with a kentrotube and subsequently to close the fistula.

**Entero-anastomosis.**—A simple entero-anastomosis is the establishment of communication between two portions of the intestine. The simplest form of all is a lateral anastomosis. The object of entero-anastomosis is to enable the fecal stream to pass around some obstruction. The portion of the intestine which is thus eliminated must not be too great, since although it remains within the body its digestive power is not utilized.