THE FUNCTIONAL RESULTS AFTER SPHINCTER-SAVING RESECTIONS OF THE RECTUM

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by

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UNDOUBTEDLY THE MOST exciting development in the surgery of rectal cancer in recent years has been the attempt to revive sphincter-saving excisions in the radical treatment of this disease. Of course it has always been the ambition of right-thinking surgeons to be able to excise malignant growths of the rectum without having to sacrifice the wonderful anal sphincter apparatus, but earlier experiences at the turn of the century with operations of this type had not been very happy and after a brief period of popularity they fell out of favour in this country and America, though still employed in Germany and Austria.

The present re-awakening of interest has been due to the important researches on the spread of rectal cancer by Cuthbert Dukes (1940) and Heinrich Westhues (1934). They have provided solid pathological grounds for believing that sphincter preservation is compatible with the requirements of radical surgery for most growths in the upper half of the rectum or rectosigmoid. Whether this is in fact so can only be decided by an extended trial in actual practice and that is now being undertaken in many centres in the United States and in Britain, including St. Mark's Hospital. As my senior colleague, Mr. Lloyd-Davies (1950), has already reported, the immediate post-operative mortality and morbidity in our cases treated on this principle has been no higher than that following combined excision. But whether the late results will be as good still remains to be seen, because unfortunately a sufficient number of cases subjected to these operations has not yet been followed up for a long enough period to permit of a reliable assessment of the remote results. Of one thing I am quite certain, however, and that is that unless they can show as good ultimate results as the abdomino-perineal excision of Miles, they will inevitably be abandoned, again except possibly for palliative purposes, because, though a colostomy is an inconvenience, patients can be taught to minimise the disability and in most cases are able despite it to lead comfortable and useful lives. I am sure that no sound surgeon would be prepared to accept for his patients any lowering of the prospects of ultimate cure in order to save natural continence.

Another essential condition for the survival of these operations and their permanent incorporation in surgical practice is that they should in fact preserve anal continence. Unfortunately after some of them, though the sphincters are conserved, rectal function is far from perfect and it is

difficult to see in what way the patients are better off than with a colostomy. If a patient must have a leaky, incontinent anus, experience has taught that it is much better that it should open on the anterior abdominal wall where it can be properly tended than in the perineal region where it may be out of sight but is certainly not out of reach of other senses. At St. Mark's Hospital we have made a careful study of the functional condition of our patients after sphincter-saving excisions for carcinoma, and in this lecture I am going to tell you something of our findings. As similar problems are presented by other forms of rectal resection with sphincteric preservation undertaken for non-malignant conditions such as prolapse of the rectum, ulcerative colitis or polyposis coli, it has seemed to me logical to include in my survey also cases treated by these procedures.

But before examining the functional results in our post-operative patients I should like briefly to recapitulate the salient facts in the physiology of normal anal control, so that we may perhaps better appreciate how disorders of continence may arise after these various operations.

Normal Mechanism of Anal Continence.

The escape of contents from the rectum is of course controlled by the contraction of the sphincter muscles which surround the anal canal. These comprise not only the internal and external anal sphincters but also, according to Milligan and Morgan (1934), the pubo-rectales parts of the levator ani muscles. These muscles normally exhibit a moderate degree of resting tone but this may have to be rapidly reinforced to deal with a sudden rise of intra-rectal tension or relaxed to permit of emptying of the rectum. Obviously therefore an integral part of the mechanism of anal control is the sensibility of the rectum which indicates to the C.N.S. the degree of rectal distension and the imminence of defæcation.

The nature of the stimulus to the rectum which produces the sense of fullness interpreted by the patient as a desire to defaecate or to pass flatus is not known for certain. The rectal mucosa and wall however are insensitive to many of the stimuli which cause pain or other sensation when applied to the skin, but are sensitive to distension, and it is probable therefore that the desire to defæcate is due, as suggested by Hurst (1911), to the sudden distension of the rectum by the descent of fæces from the lower sigmoid colon as a result of massive colon peristalsis, usually postprandial. Certainly a similar sensation of rectal fullness can usually be produced by distending the rectum with an inflatable balloon introduced per anum, and this has been the procedure adopted in most experimental investigations of rectal sensibility including those of Hurst (1911), and of Hughes and myself (1951). While inflation of such a balloon in the sigmoid colon causes a purely abdominal sensation of colic referred to the suprapubic region, balloon distension of the rectum from about 15-20 cms. above the anal orifice down to the ano-rectal ring, and particularly the lower third of the rectum, produces a sensation as if the rectum were uncomfortably full of flatus or fæces. This feeling

of fullness rapidly wanes or disappears entirely in the course of a minute or so, and at the same time the pressure in the balloon also falls; the explanation being, as Hurst has pointed out, that the rectal wall exhibits plastic tone and rapidly relaxes in response to distension so as to lower intra-rectal tension to its previous level. As a consequence the controlling sphincter contractions need only be maintained for a very brief period at a time, and this effects considerable economy of muscular effort.

The distinction between fæces and flatus. A remarkable thing about rectal sensibility is the way in which it enables a person to distinguish with reliability between fæces and flatus ; only when the motions are liquid, as during diarrhœa, are errors liable to be made. Just what the distinction depends on is not known for certain. It may be that differences in pressure between fæces and flatus are responsible, because many of our patients, undergoing balloon distension of the rectum, stated that the first sensation they experienced was that of flatus in the bowel, but on increasing the pressure in the balloon this sensation gave way to one of actual fæces. We have no evidence however to show that flatus ordinarily generates lower pressure in the rectum than does fæces. Probably the differentiation depends in part on the detection by the rectum of some other properties, physical or chemical, in its contents.

The precise location of the nerve endings sub-serving rectal sensation is not known. One might think it would be an easy matter to demonstrate them histologically, but unfortunately morphologically recognizable sensory nerve endings do not exist in the bowel wall. Afferent impulses presumably originate in free unencapsulated nerve terminals which unfortunately cannot be distinguished from the nerve endings of the intramural plexus. Hurst claimed, without producing any real evidence, that sensation was experienced in the muscularis, whilst Garry (1933) showed that sensation could be abolished by painting the rectal mucosa with a cocaine solution, suggesting that the endings lay in the mucous membrane. In the latter experiments however the cocaine might conceivably have been absorbed into the muscle coat as well, as Garry admits, thus invalidating his conclusion.

The matter is of some practical importance because, if the endings were situated in the muscularis, then the ano-rectal mucosa could be sacrificed in its entirety down to the muco-cutaneous junction without loss of essential rectal sensation, provided that the muscular coat were preserved intact. In some operations this manoeuvre is adopted with results which I shall discuss presently.

The next question to be considered is the pathway for afferent nerve impulses from the rectum to the spinal cord. There are three possible routes for afferent fibres from the rectum to the cord as follows :—

(*a*) Inferior hæmorrhoidal and pudendal nerves→sacral plexus→ sacral segments of cord 2, 3 and 4.

(*b*) Parasympathetic nerves → pelvic plexuses → nervi errigentes → sacral segments 1-2.

(*c*) Sympathetic nerves → pelvic plexuses → pre-sacral nerve → lumbar splanchnics → sympathetic trunk → lumbar or thoracic cord.

Theoretically afferent fibres could run along any or all of these routes. Hughes and I (1951) however have found that rectal sensation is unaffected by inferior hæmorrhoidal nerve block, or by bilateral total sympathectomy (Grimson's operation for hypertension), but is abolished by a low spinal anæsthetic up to S_1, thus showing that the normal route for transmission of afferent impulses from the rectum is via the parasympathetic.

In the cord the nervous impulses are conveyed from the sacral region to the sensory cortex and there appreciated in consciousness. The anal sphincter apparatus can then be voluntarily contracted or relaxed according to the wishes of the individual. It appears probable that even before this consciously activated contraction there may be an entirely reflex contraction of the sphincter musculature, because Gaston (1949) was able to evoke contraction of the external sphincter by balloon distension of the rectum in a sleeping patient who had no subsequent recollection of the event. And we have frequently noted during minor rectal operations that, if the general anæsthesia is sufficiently lightened, stimulation of the rectal mucosa leads to a brisk contraction of the anal sphincter and puborectalis muscle. That the reflex arc involved is not simply a spinal reflex but reaches a higher, probably subcortical, level is shown by the fact that no reflex contraction of the external sphincter can be elicited in a patient with a spinal lesion in the lower thoracic region (Gaston 1949). In the ordinary way this reflex action is rapidly reinforced by a voluntary contraction as rectal sensation is registered in consciousness. Further, the fine differentiation between fæces and flatus and the subsequent decision as to whether the sphincter contraction should be maintained or relaxed—indispensable components in the mechanism of continence—are presumably entirely conscious processes. There seem to be good grounds therefore for regarding anal continence as an essentially conscious activity and not a reflex one.

Regarding the motor side of the apparatus, I do not require to say anything about the external sphincter or puborectalis muscles, but I should like to comment on the internal sphincter. Unlike the external sphincter or the puborectalis muscle, it is an involuntary muscle, not under conscious control, and consequently cannot be actively contracted. Further, the reflex behaviour of this sphincter in response to distension of the rectum in normal subjects has been found by Gaston (1949) to consist of relaxation, not contraction, as occurs with the external sphincter under similar circumstances. On the face of it, therefore, it is difficult to see what part the internal anal sphincter can play in the mechanism of anal continence. To obtain more direct information however about the function of this muscle the opportunity was taken in five cases recently to divide it and to see what happened. I should explain that the first three

patients had rectal carcinomata and four weeks later had their rectums removed by combined excision. The other two were undergoing hæmorrhoidectomy. On interrogation of these patients afterwards it was found that one had slight transient difficulty in controlling flatus, which rectified itself in three or four weeks. In the other four cases no disturbance of any kind was recorded, so that apparently the internal sphincter does not play an indispensable part in the maintenance of anal continence. I felt that it was important to establish this point because several surgeons such as Bacon have suggested that poor control after abdomino-anal excision may be due to injury to this muscle.

The Functional Results obtained in 171 Patients treated by Various Forms of Resection of the Rectum and Rectosigmoid with Restoration of Continuity.

And now I shall analyse the functional results which we have obtained in our series of 171 cases treated by different types of resection of the rectum or rectosigmoid with restoration of continuity. In respect of each operation I propose to describe, firstly the scope of the excision as it affects the motor and sensory sides of the sphincter apparatus, secondly the objective effects on the component parts of the sphincter mechanism, and thirdly the quality of rectal function enjoyed by the patients submitted to it.

Anterior Resection (120 cases.)

These low anterior resections were performed after the fashion described by Dixon (1939) and Wangansteen (1945). The amount of rectum removed depended on the site of the lesion. Thus if the growth lay in the rectosigmoid, well above the peritoneal reflection, the main part of the rectum was left undisturbed in its bed in the hollow of the sacrum and the resection was carried out as an entirely intra-peritoneal procedure (see Fig. 1 (*a*)). With growths in the upper half of the rectum proper and closer to the peritoneal reflection, the whole rectum was usually thoroughly mobilised by dividing the pelvic peritoneum and lateral ligaments, and freeing the bowel as far as the ano-rectal ring; the distal limit of the resection was then carried to below the peritoneal reflection, often an inch or so inferior to it (see Fig. 1 (*b*)).

On examination of the cases it was found that the sphincter and puborectalis muscles were entirely normal in all of them. The upper end of the ano-rectal stump was seen on sigmoidoscopy usually to lie 10 cms. or more above the anal orifice, but in a few cases was as low as 7 or 8 cms. Balloon distension of this stump always elicited a rectal sensation indicating that the sensory supply had not been damaged.

The functional results reported by the patients on interrogation have invariably been excellent. All of them have had normal rectal sensation for flatus and fæces and have been able to control both, even when the fæces have been liquid as during a bout of diarrhœa. The act of defæcation

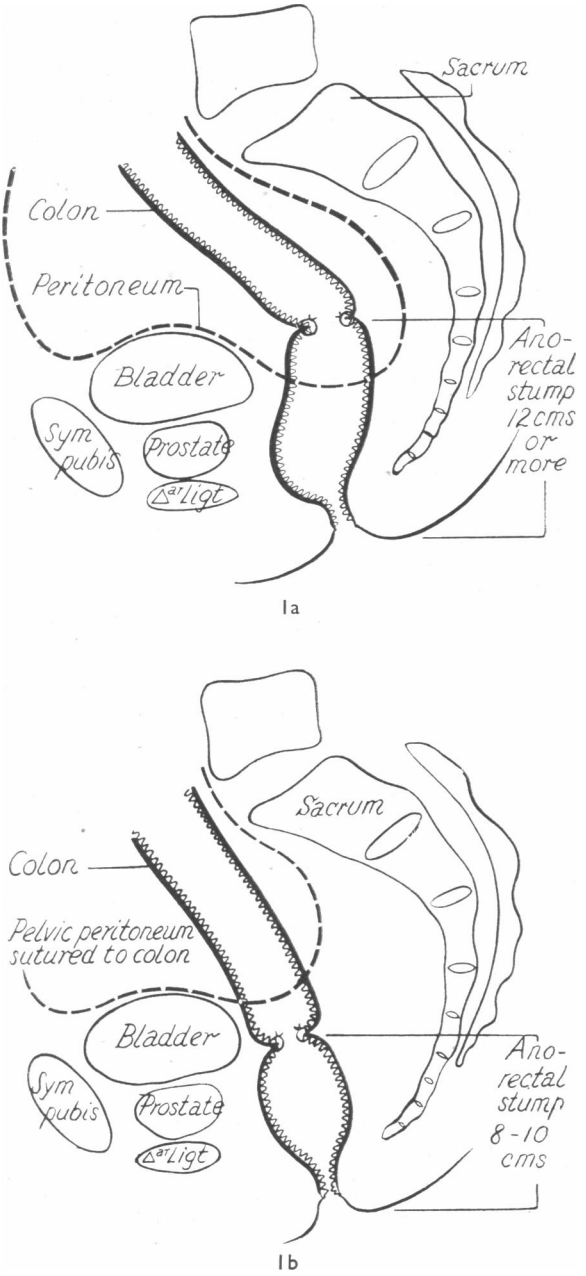

Fig. 1. ANTERIOR RESECTION.
(*a*) Entirely intraperitoneal operation. (*b*) Partly extraperitoneal operation

has been normal in every way, but more frequent motions have nearly always been required. Thus most of the patients have had at first four or five motions a day after operation, but in the course of two to six months this has been reduced to two or three corresponding to each of the main meals. It seems likely that this increased frequency is due simply to the loss of an important part of the normal fæcal reservoir. In some five or six cases, mostly those who had especially low resections down to 7 or 8 cms. from the anus, rectal sensation and control have been a little imperfect immediately after operation, but these have invariably returned to normal in ten to fourteen days. No patient after anterior resection has had to wear a perineal pad. In other words the results after anterior resections, even when the excision has been taken as low as is technically feasible through the abdomen, have been 100 per cent. perfect.

Abdomino-anal Excision of Invagination Type. (St. Mark's Hospital technique. Maunsell-Weir operation.) (18 cases.)

It should be explained that in this procedure the actual resection of bowel is conducted entirely through the abdomen as in an anterior resection except that it is carried rather lower. The ano-rectal stump being so much smaller cannot readily be united to the colon by an anastomosis in the depths of the pelvis ; instead, by means of stay sutures attached to its upper end, it is invaginated and drawn inside out through the anus (see Fig. 2 (*a*)). The colon stump is then likewise pulled down through the everted ano-rectal stump till its cut edge lies opposite the lower (really upper) edge of the rectal remnant. The edges of the two stumps are next sutured together outside the anus by the perineal operator, much in the same way as a tailor stitches the top of a sleeve into the body of a coat by turning the coat inside out (see Fig. 2 (*b*)). The completed anastomosis is finally returned to the pelvis through the anus (see Fig. 2 (*c*)). The abdominal operator now sutures the pelvic peritoneum round the piece of colon passing down into the pelvis so as to extra-peritonealise the anastomosis, and a drain is brought out extra-peritoneally from the region of the anastomosis through the lower end of the main wound. Obviously it is essential for the satisfactory performance of this operation that the patient should be in the lithotomy-Trendelenburg position (Lloyd-Davies, 1939), so that two operators may work simultaneously from above and below.

I describe the operative technique in some detail because it is not a procedure that seems to be widely known or practised, which is a pity, because, as I shall indicate presently, from the functional point of view, it is the best type of abdomino-anal excision available. It, or rather something similar, was first suggested by Maunsell, a New Zealander, in 1892, but he never actually put the idea into practice. The credit for so doing lay with Weir (1901) of New York who carried it out in 1901.

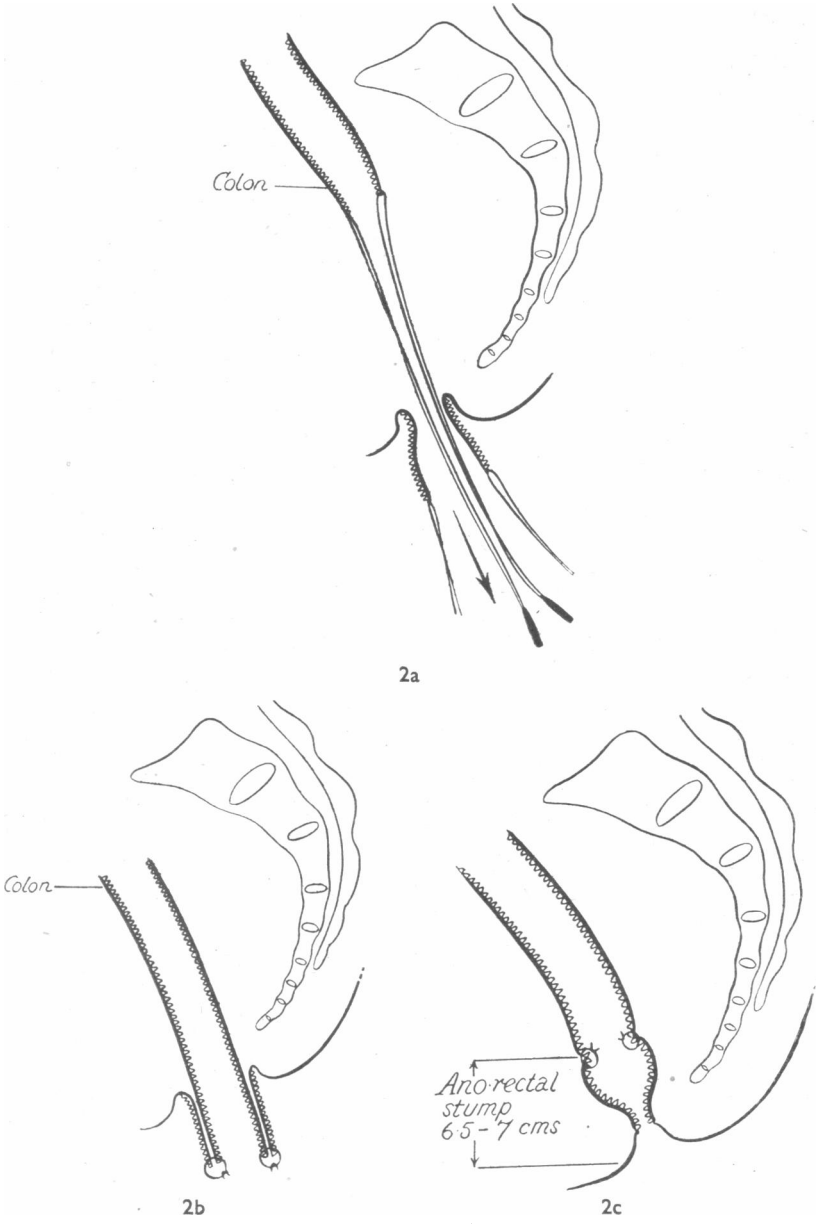

Fig. 2. ABDOMINO-ANAL EXCISION OF INVAGINATION TYPE.
(*a*) Ano-rectal stump invaginated; colon being drawn through. (*b*) Suture of ano-rectal and colon stumps outside anus. (*c*) Replacement of anastomosis in pelvis.

The same technique, however, was worked out quite independently at St. Mark's Hospital by Mr. O. V. Lloyd-Davies and Mr. C. Naunton Morgan in 1936, without any knowledge of this prior description.

By this method one is enabled to carry out a very low resection, firstly, without giving the patient a perineal or sacral wound through which a fæcal fistula might develop—such a complication being the curse of the old sacral type of resection as practised by Kraske, Hochenegg, Küttner and other Continental surgeons—secondly, without damaging the anal sphincters or levator musculature by division, though of course they are temporarily stretched, and thirdly, without denuding the ano-rectal stump of its lining mucosa.

On examination of our 18 cases treated by this operation the sphincter and puborectalis muscles have invariably been found to show normal tone and to be capable of normal active contraction; in fact from examining the sphincter musculature alone it would be impossible to detect that any operation had been performed. As for the amount of ano-rectal stump remaining, the colo-rectal anastomotic line, which frequently showed a good deal of stenosis at first, has usually been found on sigmoidoscopy to lie about 7 cms. from the anal orifice, sometimes as low as 6 or 6·5 cms. We were a little dubious as to whether a stump of this size would be adequate for sensation but the quality of function enjoyed by most of the patients has been excellent. *Thus in 14 of the 18 cases* rectal sensation and control for flatus and fæces—even liquid fæces—have, at the time of interrogation six months or more after operation, been entirely normal, though in three or four of these the control of the patients, at any rate for flatus, had been imperfect during the immediate post-operative period ; in the course of the next three to six months this improved and eventually became normal. Similarly the frequency of motions, which at first was six or eight a day in many of the cases, gradually lessened to two or three per diem. *In the remaining four of the 18 patients* though continence for solid fæces is satisfactory, an initial post-operative inability to control flatus or liquid fæces has persisted so that they find it necessary to wear a perineal pad for safety. In all four the anastomosis between colon and rectum is situated low, about 6 or 6·5 cms. from the anus, and it is to be presumed that the impairment of rectal function in these cases is due to the fact that an ano-rectal stump of this size is not always sufficient for sensory purposes. It certainly cannot be attributed to any musuclar defect in view of the normal condition of the sphincters. As for the transient incontinence experienced by some of the cases that eventually developed perfect function, this may have been caused by a temporary lesion of the sensory nerves to the ano-rectal remnant, produced by stretching during the invagination manœuvre at operation. The position then is that while most patients get good rectal function after this operation, in approximately one-quarter to one-fifth of the cases, continence is impaired.

Rectosigmoidectomy for Prolapse. (Mikulicz, 1888; Miles, 1933.) (20 cases.)

This procedure is perhaps the favourite operation in this country at present for complete rectal prolapse. The prolapse is first of all drawn down as far as possible. A circular incision is then made through the outer of the two layers of complete rectal wall, some half an inch distal to the muco-cutaneous junction. Subsequently the inner tube of rectum is pulled down as far as possible and usually the lower part of the sigmoid can be induced to emerge through the anus. The parietal peritoneum is then sutured to the front of this piece of bowel and the sigmoid cut through roughly flush with the distal edge of the everted anal canal. The two pieces of bowel are then united by catgut suture as in the abdomino-anal excision just described (see Fig. 3(*a*)) and the anastomosis is returned to the pelvis through the anus (see Fig 3(*b*)).

It will be seen that the effect of this operation, so far as the anal sphincter musculature is concerned is much the same as that of the Maunsell-Weir type of abdomino-anal excision, except that the ano-rectal stump is smaller, so that the risks of sensory incontinence would appear to be increased. Also it should be emphasized that in these prolapse cases the anal sphincters and pelvic floor musculature are usually in a grossly hypotonic condition quite apart from any operation, which has a bearing on the functional results.

In selecting patients for investigation of continence after rectosigmoidectomy we thought it better to exclude those who had developed recurrence of their prolapse—which, according to the researches made by Hughes (1949) at St. Mark's Hospital, occurs in some 60 per cent. of the patients after this operation. The 20 patients chosen therefore were non-recurrent cases living in convenient proximity to the hospital. They had all been perfectly continent before operation except when the prolapse was actually down. The period that had elapsed since operation varied from six months to three or more years. On examination three cases had normal sphincter muscles, but in all the others the sphincters were hypotonic and capable of only feeble contraction as they had been pre-operatively; the tone and power of the puborectalis sling, however, was usually rather better but not quite normal. The suture line between the colon and ano-rectal mucosa was located usually about 5 cms. from the anal orifice, sometimes a little more or less, which means that the ano-rectal stump must have been stretched by the pull of the colon in most cases after operation.

Of the 20 cases, 10 *stated* that they had normal rectal sensation for fæces and flatus and completely satisfactory control of both, but at least four of these 10 cases however admitted on interrogation that, for some weeks after the operation, sensation and control were unreliable, particularly for flatus. *The other* 10 *patients* had likewise been incontinent for flatus and liquid fæces in the immediate post-operative period. This had gradually improved but at the time of examination control was still not

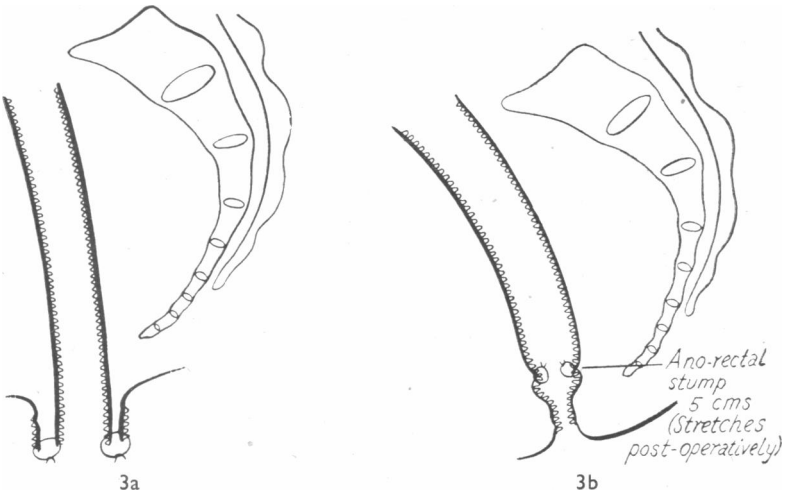

Fig. 3. RECTOSIGMOIDECTOMY FOR PROLAPSE (Mikulicz-Miles).
(*a*) Suture of sigmoid to everted anal canal. (*b*) Replacement of suture line in pelvis.

entirely normal. They were usually continent for solid fæces but never had a proper spontaneous evacuation; instead they would go to the lavatory many times a day and after much straining pass small motions consisting of little fragments of hard fæces. If they took aperients or the motions were at all loose they were apt to have sudden calls to stool which they could only control for three or four minutes if at all. As a consequence of these uncertainties of rectal function many of the patients were afraid to leave the shelter of their homes and had come to lead a secluded and isolated existence. They nearly all wore perineal pads and found them usually soiled on changing.

These poor functional results *in half the patients* would seem to be due to a combination of two factors: (*a*) the hypotonic state of the sphincter musculature and (*b*) the very short piece of ano-rectal mucosa preserved in this operation. Probably either factor alone would only have produced a few bad results because, if the sphincter muscles had exhibited normal tone, they could have responded satisfactorily to a minimal sensory stimulus from a small ano-rectal stump as they usually do after the Maunsell-Weir type of abdomino-anal excision; or alternatively even a hypotonic sphincter apparatus could have functioned adequately—as it did pre-operatively—if a more effective afferent stimulus were produced in the rectum.

Nothing really effective can be done to improve the state of the muscles, which is one of the unfortunate features of this disease, but the tendency to sensory incontinence could presumably be reduced if more of the

ano-rectal mucosa were retained in doing a rectosigmoidectomy, by making the initial circular incision at least one inch, and possibly even farther, away from the muco-cutaneous junction. I do not think that this need interfere with the efficacy of the operation as regards cure of the prolapse.

Abdomino-anal Excision of "Pull-Through Type." (Babcock, 1932; Bacon, 1945.) (5 cases.)

The abdominal part of this operation is performed in exactly the same manner in the two techniques described by Babcock (1932, 1947) and Bacon (1945) respectively, and consists of a thorough mobilization of the sigmoid colon and rectum, and division of the inferior mesenteric vessels and mesocolon. The abdomen is then closed and the patient placed in the lithotomy position for the perineal phase. *In the Babcock operation* a midline incision is made through the posterior border of the anus, the anal sphincters and the pelvic floor, and deepened into the pelvis. The rectum is then divided circularly with scissors just above the sphincters and its upper edge caught with forceps and pulled down through the anal canal, dragging the growth and the sigmoid colon with it till at least two inches of viable bowel projects beyond the anal orifice. The levator muscles are now sutured round the protruding colon, care being taken not to constrict it as it lies in the anal canal. After the perineal wound is closed and dressings are applied, the non-viable bowel is amputated and a large rectal tube tied into the anal colostomy. The state of affairs at the conclusion of the operation is depicted diagrammatically in Fig. 4(*a*). It will be seen that the anal mucosa is retained but the serous surface of the bowel obviously cannot unite with it. Healing can only take place between the colon and the cut upper edge of the anal canal, any bowel that extends beyond this level being subsequently partly removed by diathermy and partly shrivelled up spontaneously (see Fig. 4(*b*)).

In Bacon's modification of the perineal phase the anal mucosa is not preserved but instead is dissected out as a circular cuff from the muco-cutaneous junction to just above the anal sphincters. The cut is then deepened outwards through the muscular wall of the rectum, thus opening into the pelvic cavity. Another difference is that the sphincter muscles are not divided or damaged (except possibly the internal sphincter which may be injured in removing the mucosa from the canal) but merely stretched. The state of affairs at the conclusion of the operation and subsequently is shown in Figs. 5(*a*) and 5(*b*).

In our five cases submitted to a "pull-through" type of excision for rectal carcinoma, a combined Bacon-Babcock technique was employed which included both division of the sphincters and sacrifice of the anal mucosa. In all five patients on examination six months or more post-operatively the tone of the external sphincter and puborectalis muscles was very poor, almost non-existent, and active contraction negligible. No anal mucosa remained, the colon coming right down to the anal

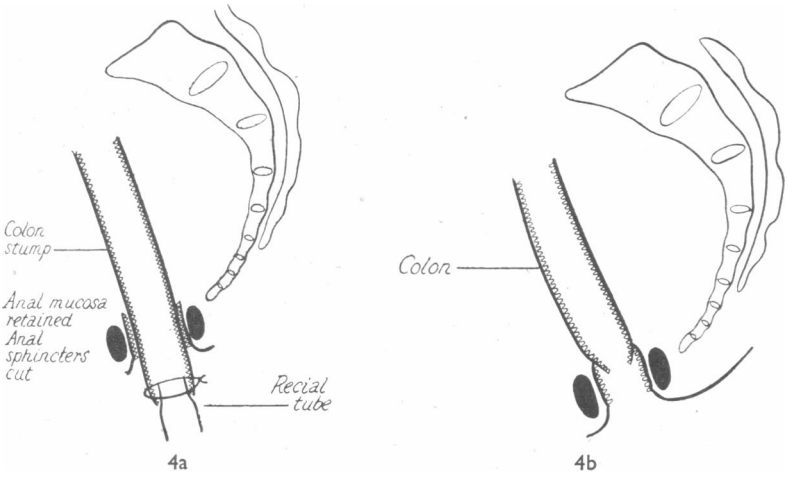

Fig. 4. ABDOMINO-ANAL EXCISION OF "PULL-THROUGH" TYPE. (Babcock operation.) (*a*) At conclusion of operation. (*b*) Final condition.

orifice or within 1 or 1·5 cms. of it, and in three cases its lining could be seen on slightly stretching the patulous anus. In one case a fibrous stenosis was present at the junction, and in another a nodule of recurrence at the anal margin.

None of the patients had any true rectal sensation, though two of them experienced a vague sense of pressure in the perineum immediately before or during evacuation, but this was much too indefinite to enable them to anticipate the event or to distinguish between flatus or fæces. In view of the atonic condition of the anus it is doubtful whether even if they had had proper sensory information, they could have exerted any effective sphincter control. As it was, flatus would escape quite unconsciously and uncontrollably. Liquid motions and to some extent solid motions as well, would discharge likewise, the first indication to the patient that a motion had taken place being the feel of fæces on the skin of the anal region or thighs. However, by regulating their colon activity by dietetic means in the same way as that adopted by colostomy cases, these patients were usually able to arrange for the main motion to occur at roughly the same time once or twice a day, so that they could go to the lavatory for three-quarters of an hour at about these times to await colon peristalsis and assist it by voluntary effort. In between motions there was always some escape of mucus and occasionally a little fæcal matter, so that the patients invariably wore a perineal pad and found that it was always soiled to a greater or lesser extent each time it was changed. An attack of diarrhœa or over-purgation, of course, completely confined them to the house. The truth of the matter is that these patients

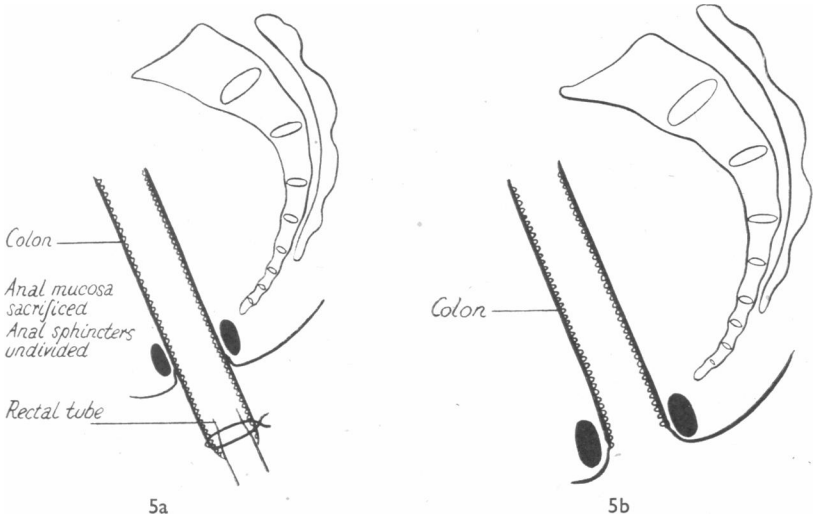

Fig. 5. ABDOMINO-ANAL EXCISION OF " PULL-THROUGH " TYPE. (Bacon operation.) (*a*) At conclusion of operation. (*b*) Final condition.

have merely had anal colostomies and I am quite certain from my examination and interrogation that they would have been at least as comfortable, and probably more so, with an orthodox abdominal colostomy.

It is possible that cases treated by the Bacon or Babcock technique alone, and therefore retaining either an intact sphincter musculature or the mucous lining of the anal canal to just above the ano-rectal ring, might get better functional results than did our cases. I have indeed on two occasions performed a " pull-through " operation without dividing the sphincter muscles *or* removing the ano-rectal mucosa. Unfortunately both patients developed the complication which as Babcock (1947) has pointed out is liable to occur if the sphincters are not cut—namely, strangulation and necrosis of the terminal part of the colon stump; and as the anal canal had not been bared of its mucosa, union had not taken place between it and the colon and the latter retracted into the pelvis. One patient died of sepsis and other complications; the other survived with a L. iliac colostomy. My feeling is that if one wants to preserve anal mucosa and undivided sphincters in performing an abdomino-anal excision it is better to use the Maunsell-Weir technique.

Total Colectomy and Partial Excision of Rectum with Ileo-Rectal Anastomosis for Polyposis Coli. (Mayo's operation.) (6 cases.)

There are several schemes of surgical management available for the rare but interesting condition of polyposis of the large intestine. One which some of us have used in recent years at St. Mark's Hospital is

that originally introduced by Dr. C. W. Mayo (1936). The first stage of this method consists in destroying the polypi present in the rectum up to a level of about 12 cms. from the anus, by means of a diathermy applied through a sigmoidoscope. Usually many sessions are required to clear the mucosa entirely of polypi. The second stage involves complete colectomy, with removal of the upper portion of rectum still containing adenomata, and end-to-end anastomosis between the terminal ileum and the lower part of the rectum (see Fig. 6). This operation has the advantage of avoiding a permanent ileostomy—a very attractive feature in these relatively young patients ; on the other hand a close follow-up must be maintained on the cases subsequently to deal endoscopically with further polypi as they arise in the rectal stump.

So far as the sphincter apparatus is concerned the effect of this operation is exactly the same as that of an anterior resection for rectal carcinoma, the actual sphincter muscles being undamaged and the size of the ano-rectal stump retained being not less than 10 or 12 cms. Owing to the more liquid nature of the ileal contents which are passed, however, the mechanism of anal control is subjected to a much more stringent test of competence than after a purely rectal resection. Yet all our six patients treated in this way, who have been re-examined six months or more after operation, have been found to be fully continent for flatus and fæces, even though there have been as many as 10 or 12 motions a day at first, including two or three during the night, and the calls to stool have been urgent. Eventually the frequency of defæcation has diminished to five or six motions or less in the 24 hours in most of the cases. Some of the patients have found that the perianal skin has become rather sore due to the frequent passage over it of digestive ileal contents, but this has usually been minimised or avoided entirely by the use of an appropriate dusting powder. No patient has had to use a perineal pad. It can fairly be claimed therefore that this operation gives complete continence.

Total Colectomy and Excision of the Rectum with Pull-Through Ileo-anal Anastomosis for Ulcerative Colitis. (Ravitch 1948.) (2 cases.)

This procedure aims at complete removal of the diseased large intestine and its mucosa and also preservation of normal anal continence by bringing the terminal ileum down to the anus through the intact sphincters. All the ano-rectal mucosa is excised down to the muco-cutaneous junction, but the muscular wall of the distal half of the rectum is preserved in the hope of retaining sensory nerve endings, which are so important in the mechanism of anal control. I personally have only done two of these operations and I used a slight modification of Ravitch's technique which I think may have made the procedure rather safer, but it would presumably not have affected the functional result. It seemed to me that the main danger of this operation lay in the risks of necrosis developing in the long ileal

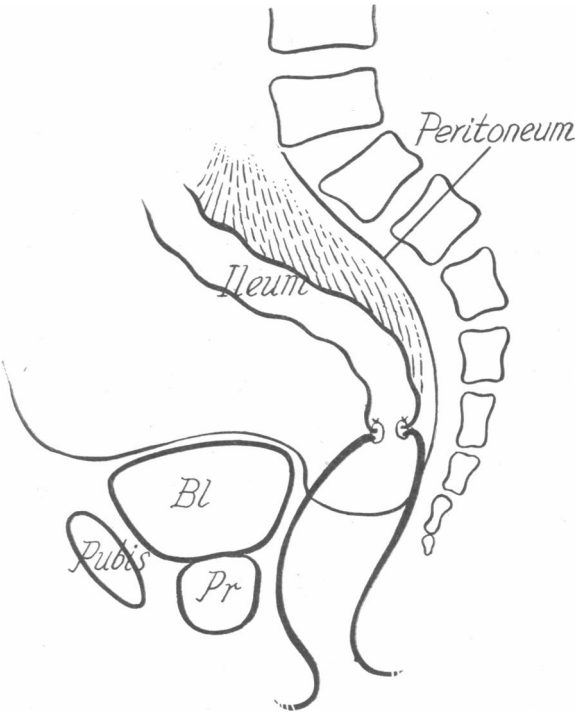

Fig. 6. SURGICAL MANAGEMENT OF POLYPOSIS.
Stage II.: Colectomy with Ileo-rectal Anastomosis.

stump brought down to the anus. If this occurred, ileal contents would then find their way into the pelvis and probably eventually establish a fistula through to the vagina or the perianal region, thus invalidating the preserved sphincter apparatus. To minimise the chances of such a fistula occurring I decided to defunction the ileal stump by making a proximal abdominal ileostomy as shown in Fig. 7. Only when the ileo-anal anastomosis had healed soundly some two or three months later was the colostomy closed. But before doing so we tested the patients for rectal sensation by inflating a balloon in the lowermost part of the ileum just above the anal sphincters. Distension almost up to the point of rupture of the balloon caused no proper rectal sensation, but only a vague, scarcely perceptible discomfort, not at all like the normal feeling of fullness due to flatus or fæces in the rectum. It appeared therefore that these patients had not retained rectal sensation, and, though the sphincter muscles were completely undamaged and capable of full normal contraction, we were prepared to find that, when ileal contents were directed to the anus, the patients would be incontinent; and that is what we did find.

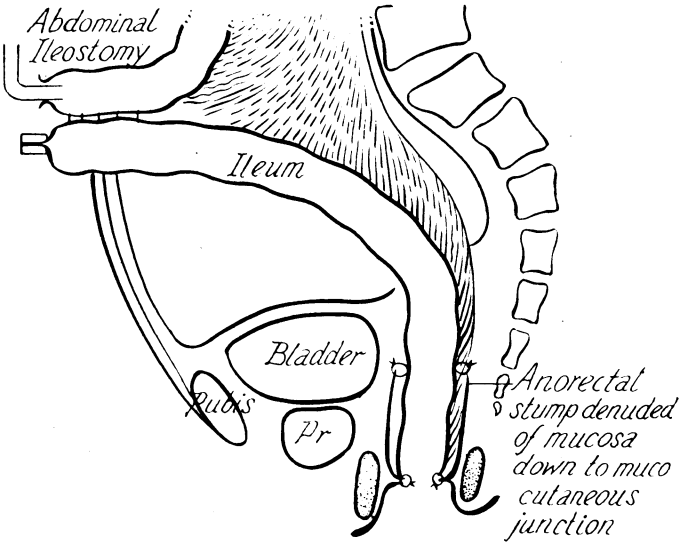

Fig. 7. ILEO-ANAL ANASTOMOSIS.
Temporary Defunctioning abdominal Ileostomy.

Unfortunately one patient only lived three weeks after the closure of the ileostomy and then died suddenly of a pulmonary embolism. But during that time she was only partly continent. By using the bedpan every hour or so and by maintaining a constant active contraction of the anus in between she was able to keep fairly clean during the day, but at night fæces were discharged incontinently. The second patient had an even less satisfactory result. She could maintain strong sphincter contractions for only short periods and leaked ileal contents frequently during the day and constantly at night. The perianal skin became raw, red and sore, her general health suffered and after two months she begged for the return of the abdominal ileostomy. This has been done and she is now comfortable. So that in both cases perfect preservation of the sphincter musculature failed to yield normal continence because rectal sensation had been lost and attempts at an artificial kind of continence based on maintained active contraction of the sphincters were unsuccessful.

My experiences of this operation have been unfortunate. It may be that, if we had preserved more of the rectum or mobilised it less during the operation and had been able to tide these two patients over for longer periods, they would eventually have developed some sort of rectal or perineal sensation that would have enabled them to use their sphincter muscles efficiently ; I certainly would not presume to condemn an operation on such a limited experience, but these results as they stand are discouraging and indicate quite clearly that the functional condition after this operation is not always satisfactory. None the less I propose to experiment further with this procedure.

CONCLUSIONS

From this survey it would appear that the features in the technique of sphincter-saving excisions essential for good function after these operations are as follows :—

(1) It is not sufficient merely to retain the sphincter muscles ; they must be preserved undivided. Once the muscles have been severed, as in the Babcock operation, it is doubtful if normal tone and contractility are ever recovered, and consequently some impairment of function is almost certain to result.

(2) The sensory function of the rectum must also be safeguarded by retention of an adequate ano-rectal stump below. An ano-rectal remnant of at least 6 cms. from the anal orifice will usually suffice for perfect function if the sphincter muscles are of normal tone and contractile power, but to be absolutely certain of normal continence it is better to retain at least 7 or 8 cms. Our evidence seems to show that preservation of the muscular wall of the rectum without its lining mucosa, as in pull-through, colo-anal or ileo-anal anastomoses, will not provide the sensory qualities necessary for proper continence.

(3) The low anterior resection is the form of sphincter-saving excision for carcinoma of the rectum that most reliably satisfies these requirements. It is fortunately an operation that is frequently practicable for growths of the upper half of the rectum or rectosigmoid.

(4) Of the abdomino-anal excisions the most satisfactory from the functional and technical aspects is the invagination type, associated with the names of Maunsell and Weir, which gives good or satisfactory function in most instances.

(5) In performing rectosigmoidectomy for rectal prolapse a cuff of at least one inch of ano-rectal mucosa should be preserved below.

(6) Though a total colectomy with ileo-rectal anastomosis is invariably followed by normal anal continence, our limited experience of colectomy and partial excision of rectum. with drawing of the terminal ileum through the rectal stump denuded of its mucosa to form an ileo-anal anastomosis, has not been encouraging.

I wish to record my grateful thanks to my colleagues at St. Mark's Hospital for kindly allowing me access to their cases and case records for the purposes of this inquiry.

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