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Pediatric surgery

Conducted by MARK M. RAVITCH, M.D.

A new surgical technique for treatment of Hirschsprung's disease

F. SOAVE, M.D.

GENOA, ITALY

*From the Fourth Division of Pediatric Surgery,
G. Gaslini Institute*

Between 1955 and 1962, 45 children suffering from Hirschsprung's disease were admitted to the G. Gaslini Institute Department of Pediatric Surgery. Swenson's operation was used on 14 of these patients; Duhamel's, on 17.

An additional 14 patients were operated on by a new technique. This consists in mobilizing the narrowed rectosigmoid segment by an extramucosal approach, pulling down the colon to the desired length, and passing it through the rectal canal (preserved intact, but denuded of mucosa) without pelvic trauma to the levators. The colon is then amputated from the perineal side. My choice of the extramucosal route for mobilization of the rectosigmoid was prompted by Romualdi's^{11,12} and Rehbein's¹⁰ papers on the treatment of cases of high-level imperforate anus with rectourethral fistula or of prostatic anus in which they (after opening, cleaning, and cutting across the upper rectum) removed the mucous membrane at the level of fistula.

Babcock's¹ pull-through procedure does not preserve the attachments of the levators. Ravitch,^{8,9} in 1947, and Devine² described a mode of restoring bowel continuity after total colectomy, bringing the ileum through a tube of intact rectal musculature denuded of mucosa and suturing the ileum to the anus. In Brazil, where acquired megacolon due to Chagas disease (Brazilian trypanosomiasis),

is endemic, Simonson¹³ and Mendonça,⁶ 1960, Raia, and others have employed this technique in the treatment of acquired and congenital megacolon.

METHOD

The operation is performed by using a combined abdominoperineal approach.

Abdominal stage. The narrowed rectosigmoid segment is prepared above the intact pelvic floor with the segment of colon to be resected (Fig. 1A).

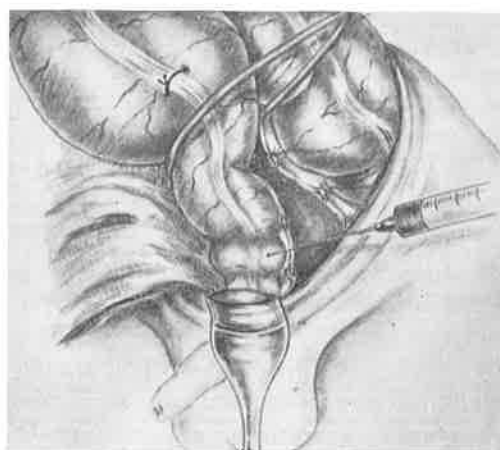


Fig. 1A. Intra-abdominal portion of procedure. After laparotomy the narrowed rectosigmoid segment is prepared above the intact pelvic floor. Novocain in 0.5 percent solution is infiltrated into the seromuscular coat of the rectosigmoid segment, care being taken to avoid involvement of the mucous coat. In this way the entire circumference of the rectosigmoid swells at the desired point due to infiltration of the serous and muscular coats.

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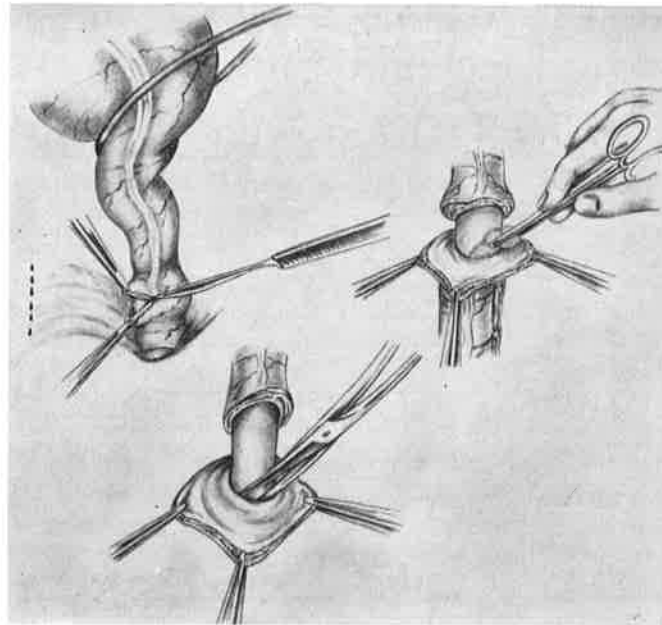


Fig. 1B. A transverse scalpel incision is made above the pelvic floor in the infiltrated region, and separation of the seromuscular layer from the mucous layer is begun and completed with dissecting scissors and the aid of a small gauze pad held by Klemmer forceps until (around the entire circumference of the bowel) the proximal seromuscular coat is separated from the distal seromuscular layer, and the underlying mucous coat is completely detached. Then, starting at the edge of the distal seromuscular coat with the long, curved dissecting scissors and the aid of a small gauze pad soaked in adrenalin and held by Klemmer forceps, the seromuscular coat is (progressively and carefully) detached from the underlying mucous coat. The maneuver is carried out without trauma to the pelvic floor and with little difficulty or loss of blood, since the adrenalin also acts as a hemostat and only a few thin vessels are ligated if necessary.

If the colon is considerably distended by gas, it is emptied by introducing a needle at a tangent to the colon axis: no suture is needed where the needle is introduced, however.

Novocain in 0.5 percent solution is infiltrated into the seromuscular coat of the rectosigmoid segment—above the pelvic floor—care being taken to avoid involvement of the mucous coat (Fig. 1B). The entire circumference of the rectosigmoid swells at the desired point due to infiltration of the serous and muscular coats.

A longitudinal incision is made with a scalpel above the intact pelvic floor in the infiltrated region and separation of the seromuscular layer from the mucous layer is

begun and completed with dissecting scissors and the aid of a small gauze pad held by Klemmer forceps until (around the entire circumference of the bowel) the proximal seromuscular coat is separated from the distal one, and the underlying mucous coat is completely detached (Fig. 1B).

Dissection. Starting at the edge of the distal seromuscular coat, with the long, curved dissecting scissors and the aid of a small gauze pad soaked in adrenalin and held by Klemmer forceps, the seromuscular coat is progressively and carefully detached from the underlying mucous coat (Fig. 1B).

This maneuver is carried out without trauma to the pelvic floor and with little difficulty or loss of blood, since the adrenalin

also acts as a hemostat and only a few fine vessels are ligated, if necessary.

Dissection is carried out under visual control as far as possible and then with the right index finger should be extended distally as far as possible toward the anus (Fig. 1C).

The dissection of the mucous coat is easy in newborn and older infants and children. At the point where the rectum joins the anus (halfway up to the levatores ani muscles) tougher adhesions are found between the muscular and mucous coats. These are carefully severed with the scissors (by the abdominal route or during the perineal stage) according to the anatomic situation.

Of particular interest is the *elasticity* of the rectosigmoid mucous coat. As the detachment maneuver proceeds, the mucous layer stretches, unlike the seromuscular canal obtained during the maneuver, which is resistant and does not alter in length. This resistance is very useful, since it facilitates detachment of the rectosigmoid mucous coat, while the edge of the seromuscular layer is held with 4 clamps.

By separating the coats of the rectosigmoid segment via the extramucosal route as far as the anorectal line, the pelvic innervation, with hypogastric, lumbosacral, and sacral plexuses, is spared (Fig. 1D).

This completes the intra-abdominal stage of the extramucosal detachment of the rectum. Before proceeding to the perineal stage, a silk thread is stitched to the colon to mark the point at which it is to be resected during the perineal stage.

Perineal stage. The anal canal is widely dilated and the mucocutaneous junction of the anus is stretched with four clamps in order to ensure as extensive a prolapse and exposure of the intra-anal mucosa as possible. A scalpel (Fig 2, A) or the scissors are used to make a slit 1 cm. above the mucocutaneous junction in the intra-anal mucosa; the incision is then completed around the entire circumference.

In this way, a *strip of distal anal mucosa remains intact*, together with the perimucosal tissues.

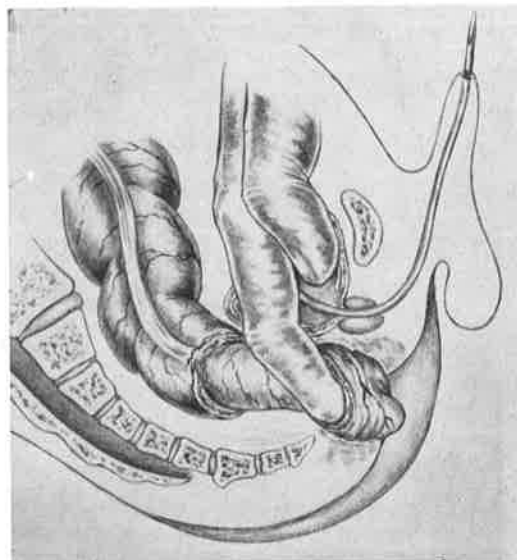


Fig. 1C. Dissection is carried out under visual control as far as possible, then with the right index finger, and should be extended distally as far as possible toward the anus.

The terminal mucous coat of the rectum is detached in its entire circumference working upward: a number of muscle fibers are resected near the level of the levatores ani muscles, which are thus spared. Preparation of the anorectal mucous coat is completed when the index finger of the abdominal operator, *inserted between the muscular and mucous coats*, encounters the finger of the perineal operator.

The mucous layer of the rectosigmoid is thus completely detached from its outer muscular and serous coats. In this way the anorectal canal remains intact outside the rectosigmoid mucous coat and it is possible to spare the external sphincter, internal sphincter, levatores ani muscles, and the hypogastric, lumbosacral, and sacral plexuses.

Pulling down of the rectosigmoid and colon. The mucous coat of the rectosigmoid is withdrawn through the anus and the colon is pulled down beyond the anal orifice until the level of section marked by the silk thread is reached. This pull-through of the colon is thus carried out without danger of intra-abdominal infection. Also spared is the in-

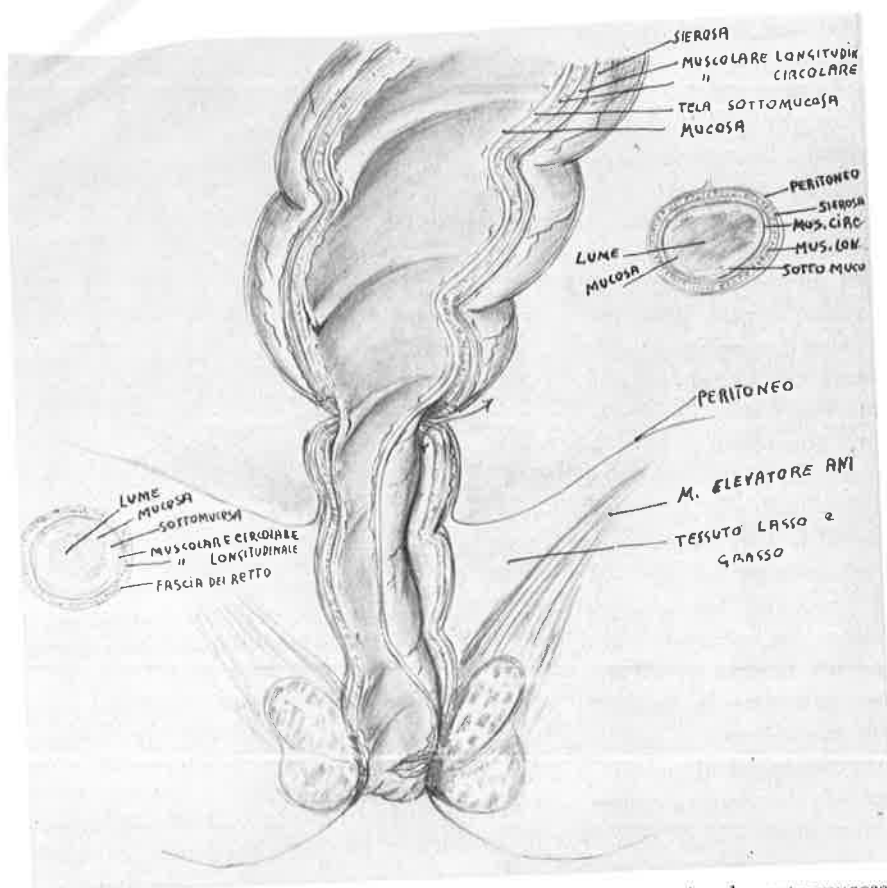


Fig. 1D. By separating the layers of the rectosigmoid segment by the extramucosal route as far as the anorectal line, the pelvic innervation (with the hypogastric, lumbosacral, and sacral plexuses) and levators are spared. This completes the intra-abdominal stage of the extramucosal detachment of the rectum. Before proceeding to the perineal stage, a silk thread is stitched to the colon to mark the point at which it will be sectioned during the perineal stage.

nervation of the bladder, genital organs, and sphincters (Fig. 2, lower left, right).

After having prepared the colon, the pull-through may sometimes be a little difficult because of the presence of residual fecal masses in the colon, notwithstanding pre-operative preparation. In this case a large rubber tube is introduced into the rectosigmoid and colon and with a cleansing enema the feces are softened and easily expelled by gently squeezing the large bowel from the abdominal side.

Drainage of the rectoanal canal. With the aid of Klemmer forceps a Penrose drain is introduced between the lowered colon and seromuscular coat to avoid accumulation of

blood or serum above the pelvic floor in the abdominal cavity (Fig. 3) and between the serosa of the colon and the muscular coat of the rectal canal.

After fixing the Penrose drain in position (indicated by the arrow in Fig. 3) the edge of the seromuscular layer protruding above the pelvic floor is stitched with 4 silk stitches to the outer surface of the colon. This achieves the twofold objective of closing the pelvic floor and attaching the colon to the seromuscular coat. Within 2 to 3 days the Penrose drain is removed.

Colon resection. After the abdomen has been closed, leaving a Penrose drain in place on the perineal side, the lowered colon is

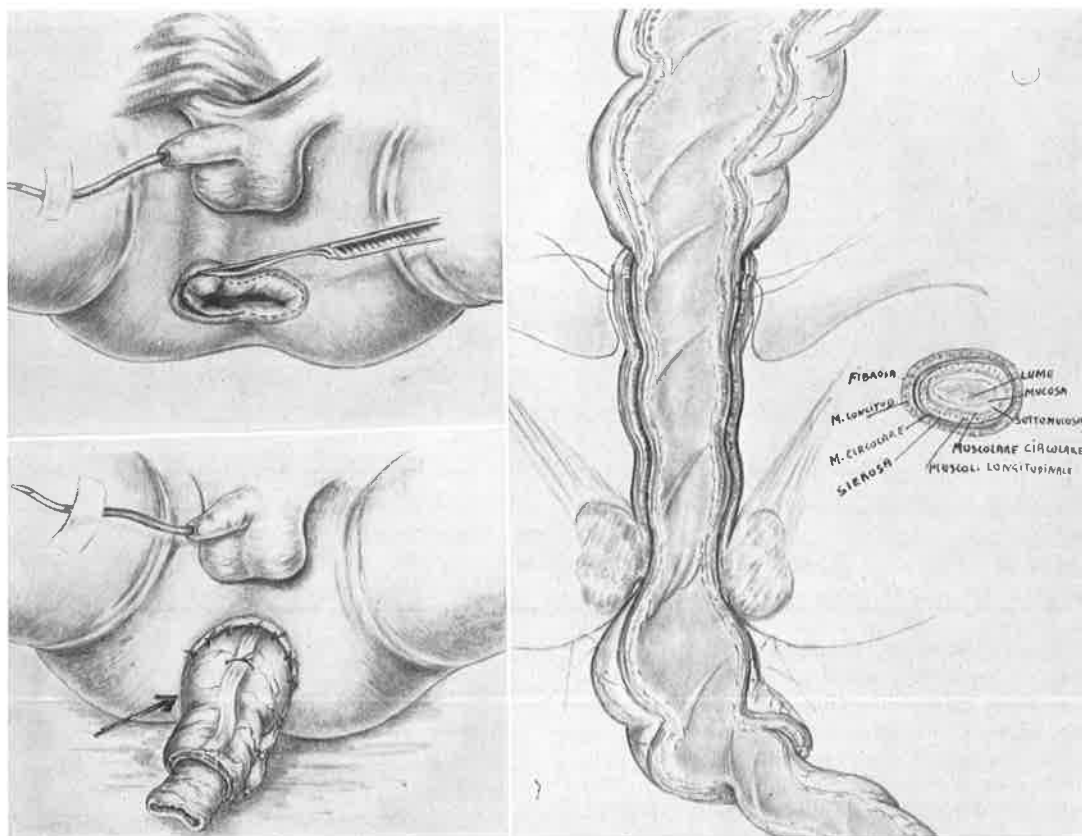


Fig. 2. Perineal procedure. *A*, The anal canal is widely dilated and the mucocutaneous junction is stretched with 4 clamps in order to ensure as extensive a prolapse and exposure of the intra-anal mucosa as possible. Scalpel or scissors are used to make a slit 0 to 1 cm. above the mucocutaneous junction in the intra-anal mucosa; the incision is then completed around the entire circumference. In this way a small strip of distal anal mucosa remains intact, together with the perimucosal tissue. The terminal mucous coat of the rectum is detached in its entire circumference, working upward: a number of muscle fibers are divided near the level of the levatores ani muscles, which are thus spared. Preparation of the ano-rectal mucous coat is completed when the index finger of the abdominal operator, inserted between the muscular and mucous layers, encounters the finger of the perineal operator. *B*, The mucous coat of the rectosigmoid is withdrawn through the anus and the colon is pulled down beyond the anal orifice until the point of resection marked by the silk thread is reached. *C*, This pull-through of the colon is carried out without danger of intra-abdominal infection. Also spared is the innervation of the bladder, genital organs, and sphincters.

amputated at the predetermined point, leaving a stump protruding 5 to 10 cm. from the anus (Fig. 4, *A*). This stump is anchored with 4 silk stitches to the skin of the perineum.

Tube in lowered colon. A rubber tube or rectal sound 1 cm. or more in diameter (depending on the child's age) is inserted into the lumen of the colon and tied to it with a silk stitch attached peripherally to the colon stump protruding from the anus.

Gases and the intestinal contents are drained through the tube, which partly avoids postoperative abdominal distension. It may be left in place for several days, since with the proposed technique a suture is not required. Generally it is expelled spontaneously. Within 10 to 12 days a circular adhesion forms between the serous coat of the colon, the mucous wall of the anus, and the fibromuscular coat of the rectal canal (Fig. 4, *B*).

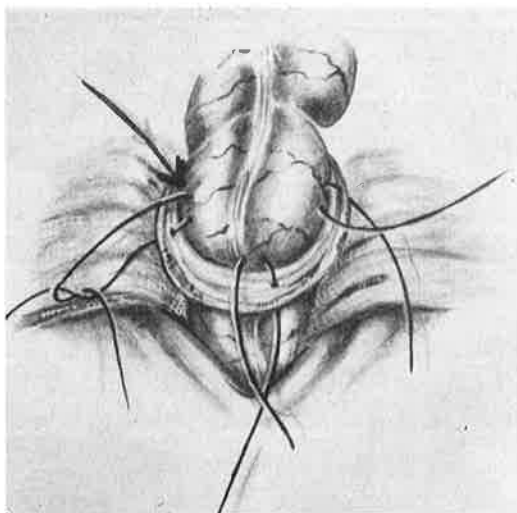


Fig. 3. From within the abdomen a Penrose drain is introduced between the lowered colon and the seromuscular coat to avoid accumulation of blood or serum above the pelvic floor in the abdominal cavity, and between the serosa of the colon and the rectal muscular canal. After fixing the Penrose drain in position (indicated by the arrow) the edge of the seromuscular layer protruding above the pelvic floor is stitched with 4 silk stitches to the outer surface of the colon. This achieves the twofold objective of closing the pelvic floor and attaching the colon to the seromuscular coat.

Resection of colon stump after 15 to 20 days. After 15 to 20 days the colon stump protruding from the anus is cut by cautery, and it is necessary to ligate those bleeding vessels which are found in the severed segment. The severed end withdraws into the anal canal after a few hours, or sometimes immediately with a slight finger pressure.

DISCUSSION

By means of the proposed technique, which, although simple, requires considerable care, it is possible to achieve (without suture) an anastomosis between colon and anus which is in good functioning order in several weeks, by which time the edema of the colon stump (withdrawn into the anal canal) is resolved.

A rectal finger examination following removal of the colon stump (by cautery after 15 to 20 days) enables the progressive reso-

lution of the edema to be followed. At first this is felt as a protruding, circular band within the intestinal lumen, between the anus and lowered colon (spontaneous anastomosis line), giving the impression of a rigid circular section. However, within 6 to 12 weeks after institution of daily dilatation it cannot be palpated at all, and the finger penetrates easily into the new anal canal.

DILATATION

Dilatation of the new anal canal is easily carried out during the period of edema reabsorption. Indeed, no retraction remains at the level of the anus and there is only a circular ring between the anus and colon: This disappears within 6 to 12 weeks.

The object of early dilatation is to avoid constriction of the colon during the post-operative period of readaption. The edema persists for several weeks and the walls of the colon require a little time to regain their normal peristaltic activity.

By preserving the newly formed anorectal canal with dilating stimulation one avoids the danger of fecal accumulation and irritation of the mucosa, which must be protected if it is to reacquire its anatomic and functional integrity.

Before the patient is discharged we instruct the mother in the dilatation procedure and give her a conic dilator with progressively increasing diameter, from 1 to 2½ cm. In this way only one dilator is required and need be inserted only once to obtain the desired degree of dilatation. Dilatation must be continued until the anocolic anastomosis remains at a satisfactory caliber.

POSTOPERATIVE PHYSIOLOGY

The segment of intact anal mucosa remaining after the operation is functionally normal and controls the defecation reflex when the newly formed rectum is full of feces. Expulsion of the feces is taken care of by the colon and levatores ani muscles. These are still attached to the rectal muscular coat, which has been left in situ and within a few weeks adheres its entire length to the walls of the lowered colon (Fig. 2, B).

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Fig. 4. The anastomosis. A, The lowered colon is resected at the predetermined point, leaving a stump protruding 5 to 10 cm. from the anus. The Penrose drain is visible on the child's left. A rubber tube or rectal sound 1 cm. or more in diameter (depending on the child's age) is inserted into the lumen of the colon and tied to it with a silk stitch attached peripherally to the colon stump protruding from the anus. Gases and the intestinal contents are drained through the tube, partly avoiding postoperative abdominal distension. It may be left in place for several days, *since with the proposed technique a suture is not required.* B, Generally within 15 to 20 days a circular adhesion forms between the serous coat of the colon, the mucous wall of the anus, and the fibromuscular coat of the rectal canal.

The seromuscular canal preserves entirely its topographical anatomical relationship with the levatores ani muscles and the pelvic nerve plexuses; those plexuses regulate for

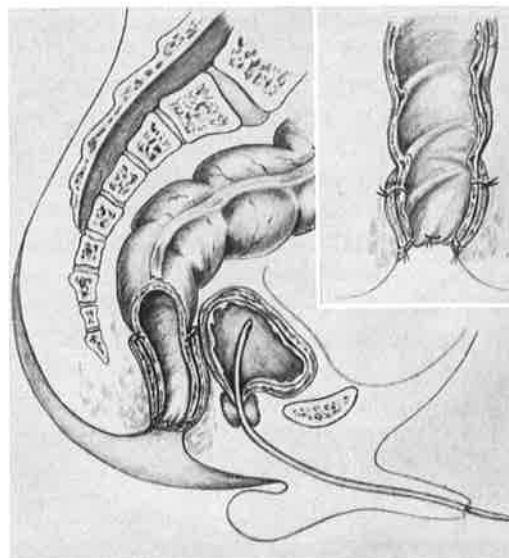


Fig. 5. After 15 to 20 days the colon stump protruding from the anus is cut by cautery. The severed end withdraws into the anal canal after a few hours, sometimes immediately with a slight finger pressure.

the colon the functional stimuli which, together with the anal reflex and colonic peristalsis, ensure better than any operation the motility of the newly formed rectum.

With the proposed technique the colon is pulled down to the level of the anus, thus avoiding the risk of functional spasm and obstruction to fecal passage. This spasm often occurs after Swenson's operation, since the rectal segment remaining after the pull-through maneuver and end-to-end suture is always rather long and may also be aganglionic. This makes it susceptible to reflex stimuli which, in turn, lead to persistence of the functional obstruction and favor the accumulation of feces and postoperative enterocolitis. Fecal accumulation and secondary postoperative enterocolitis are caused by functional obstruction and must be avoided (so as not to revert to the preoperative pathology) by removing the final direct cause of the obstruction, namely: the nonfunctioning rectal segment.

With the proposed technique this danger is obviated, since the colon reaches the level of the anus.

Clinical findings. I have used the technique described here in 14 patients aged 2 months (1 patient), 5 months (3 patients), 6 months (1 patient), 2 years, (3 patients), 5 years, (2 patients), 6 years (2 patients), and 7 years (2 patients). The postoperative course was excellent in each case. In the unweaned child the tube insured canalization of the bowel within 1 to 2 days. No bladder disorders occurred and sphincter control was complete from the very first. A number of patients were followed-up for over 20 months and, according to the parents, the final outcome was excellent in each case; no instances of enterocolitis or diarrhea have occurred.

CONCLUDING REMARKS

The described nonsuture technique of anal-colon anastomosis following extramucosal mobilization and lowering of the rectosigmoid appears (among the techniques used to the present time in the surgical treatment of Hirschsprung's disease) the most certain for the re-establishment of the normal physiologic conditions of intestinal peristalsis and of functional neurophysiology of the new rectum, since it spares pelvic innervation and does not cause disorders of the bladder, genital organs, or internal and external sphincters.

The proposed technique appears to be a radical rather than palliative treatment of Hirschsprung's disease, and may be used on newborns, older infants, and children.

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