

Y-U Advancement Pyloroplasty

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Heineke in 1886 and von Mikulicz in 1887 independently described the popular method of pyloroplasty by longitudinal incision and transverse closure. In some patients, particularly children, the Heineke-Mikulicz procedure has not always been satisfactory because of inadequate size and distortion of the muscular gastroduodenal funnel. In 1958, Moschel and co-workers reintroduced the concept of the Y-V advancement principle to enlarge the pylorus. This operation has not been widely adopted but has a number of attractive features, including simplicity, safety, and maximal channel size with minimal operating time.

The standard Y-V principle has been modified in favor of a broadly based U-shaped pedicle constructed from the presenting surface of the gastric antrum which is advanced into an incision made in the anterior duodenum. This operation has been used in 33 patients, who range in age from 3 weeks to 17 years. They have been variously followed from 6 months to 10 years. The surgical need for pyloroplasty in this group of patients included hiatal hernia with delayed gastric emptying (19 patients); vagotomy for ulcer (7 patients); esophageal substitution (4 patients); vagotomy for reflux esophagitis (2 patients); and, in one instance, revision of an obstructed Heineke-Mikulicz pyloroplasty. Complications have been minimal; gastric drainage has been highly satisfactory. In long-term followup, no ill effect has been seen from the presence of antral mucosa in the proximal duodenum.

THIRTY/THREE INFANTS and children have undergone pyloroplasty at the Children's Hospital in the past 10 years. The major conditions requiring pyloroplasty were 1) delayed gastric emptying associated with hiatal hernia and gastroesophageal reflux, 2) duodenal ulcer, and 3) esophageal replacement for caustic ingestion. The technique used for widening the pylorus in this group of patients is a Y-U plasty; in this procedure a tongue of antrum is advanced into an incision in the presenting surface of the proximal duodenum. The patients have been followed from 6 months to 10 years and the information gained from them forms the basis of this report.

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Historical Perspective

In 1919 Dr. Shelton Horsley, in the opening of his paper describing a new approach to pyloroplasty, stated that "there is no excuse for a new operation if the old ones are satisfactory."⁷ Reports dealing with plastic surgery of the pylorus have been many and varied and their proliferation would seem to lend credence to Dr. Horsley's statement that, even today, a perfect pyloroplasty does not exist. In 1886, Heinecke⁵ and a year later Mikulicz¹⁴ separately described experience with a longitudinal incision through the pylorus and the transverse closure which has been used the world over. In 1892, Jabouley⁹ devised gastroduodenostomy for bypassing an obstructed pylorus. Finney,³ of Baltimore, extended the Jabouley incisions, connecting them through the pylorus to achieve a much wider stoma. Horsley (1919),⁷ Judd (1922)¹² and Weinberg (1956)²³ all introduced modifications of the Heinecke-Mikulicz principle, retaining its basic simplicity.

In his beautiful essay on "The Story of Pyloric Stenosis," Ravitch¹⁹ has pointed out that Nicoll of Glasgow in 1906¹⁶ was the first to record surgical use of the Y-V principle at the pylorus. Nicoll performed his operation using a seromuscular incision without entering the mucosa, reporting satisfactory results in several infants with pyloric stenosis. Rosoff,²⁰ has unearthed the fact that Dr. J. B. Blake of Boston described the use of a Y-V pyloroplasty for duodenal ulcer, citing Blake's remarks which were made in discussion of Dr. Horsley's paper of 1919.² Blake should be credited with the observation that this particular pyloroplasty has application to patients in whom an anterior duodenal ulcer must be excised. His description is as follows: ". . . a procedure

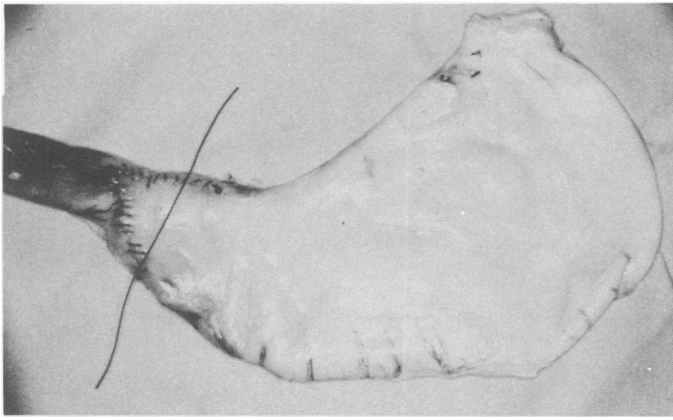


FIG. 1. Formalin specimen of animal stomach after Y-U advancement pyloroplasty. Widening at pylorus is apparent.

which I have employed a number of times after excision of a duodenal ulcer. By taking a tongue-shaped portion of the pyloric antrum and pulling it through the incised ring the defect left by removal of the ulcer may be corrected."²

In 1958 Moschel, Walske and Newmayer¹⁵ described their experience with a pyloroplasty using the Y-V principle. These workers emphasized the need for a blunt or U-shaped pedicle to insure adequate blood supply at the tip of the antral flap. The elegant simplicity of this procedure makes it especially adaptable to young patients where 1) maximal channel circumference, 2) minimal dissection, 3) short operative time, and 4) the least disruption of anatomy are the goals of the operation.

The Y to V plastic operation has been frequently used in pediatric surgery for the correction of various forms of congenital stenosis. Adaptation of this principle seemed a natural step in the treatment of infants and children requiring pyloroplasty.

Laboratory Experience

After the report of Moschel, *et al.*¹⁵ describing satisfactory clinical trials with a Y-V pyloroplasty, the operation was studied in our laboratory to evaluate its immediate and long-term effects in adult dogs and puppies. This experience has been previously reported^{17,18} and is briefly summarized here.

For initial trials a standard Y-V plasty operation was used. Six adult dogs were operated upon and a V-shaped pedicle of the anterior distal antrum was outlined. A longitudinal incision was made in the presenting surface of the duodenum from the pylorus distalward. The pedicle so fashioned was then drawn down into the duodenum and sutured in place. Of the first 6 animals undergoing such an operation, 3 had complications referable to blood supply in the apex of the pedicle. Consequently, the tip of the pedicle was blunted (as Moschel

and co-workers had recommended) and a flap of gastric tissue was constructed so that the tip and the base were of nearly equal width. The tongue of antrum was advanced and sutured into an incision in the anterior duodenum wedging open the pyloric canal (Fig. 1). Twenty such operations were carried out on adult mongrel dogs. The procedure was then performed on 14 recently weaned puppies. Because of other protocol objectives, 10 of the 14 puppies also had a transabdominal truncal vagotomy at the time of pyloroplasty. Weekly weight changes and growth patterns were determined in the puppies. The animals were sacrificed periodically from 4 to 12 weeks after operation.

In the 20 adult dogs undergoing pyloroplasty using the broad-tipped pedicle, there was one leak which the animal survived. At intentional sacrifice, it could not be proved whether this single instance of leakage was attributable to defective blood supply and necrosis or to a technical error at the suture line. Two of the puppies having transabdominal truncal vagotomy and pedicle pyloroplasty died of pulmonary complications at 6 and 21 hours postoperatively. In both, the pedicle appeared healthy, suture lines were intact, and there was no evidence of aspiration. It was concluded that these deaths were associated with the fragility of the young animals and not related to the pyloroplasty. In the other 12 puppies the pyloric operation was well healed at sacrifice (Table 1).

In all of the animals the pylorus was widened by at least 30% of its total circumference. Gastric emptying was seen to be adequate as evidenced by the ability of the dogs to eat a normal diet at regular intervals without vomiting, and by a barium swallow study of randomly selected animals.

Autopsy of all adult and young dogs revealed a well healed gastric pedicle. There was a clean, well healed mucosal junction with no significant tissue turn-in. Of particular interest was the evidence of adaptation of the gastric pedicle to its new duodenal environment. The gastric pedicle became smoothly incorporated into the duodenal wall, (Fig. 2) losing some of its thickness and assuming a texture more nearly that of the thinner duodenum. The dog's pylorus is freely mobile which reduces its comparability to the human subject, but the results of these studies seemed to support the safety and good function of the operation. Accordingly, clinical use was begun in our hospital for those infants and children needing pyloroplasty.

TABLE 1. Y-U Advancement Pyloroplasty in Animals

Type	Number	Deaths	Non-fatal Leaks	Complication Rate
Y-V	6	2	1	50%
Y-U	34	0	1	3%

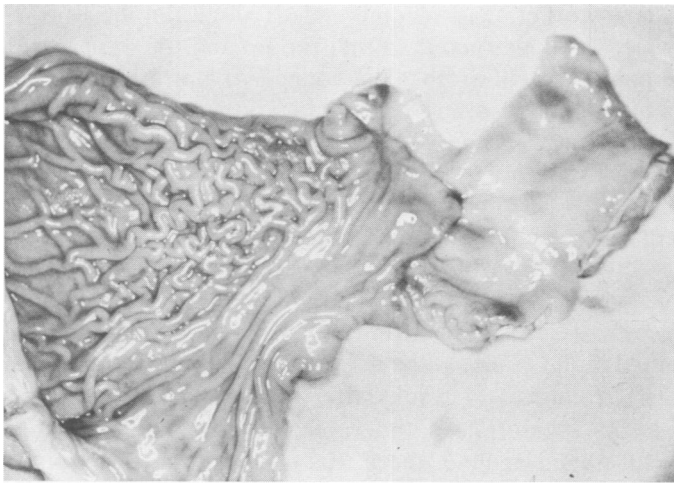


FIG. 2. Formalin-fixed animal stomach opened from posterior aspect to demonstrate healed mucosal surface at site of the pyloroplasty. (Reprinted from *Current Topics in Surgical Research*, 1:291, 1969.)

Operative Technique

A full-thickness, U-shaped pedicle is constructed from nearly all of the presenting surface of the antral portion of the stomach (Fig. 3). The width of the flap should measure at least two-thirds of its length. It is important that the tip be nearly as broad as the base. An incision in the presenting anterior surface of the duodenum is made from the pylorus distalward; this incision should be slightly shorter than the length of the pedicle. To prevent infolding tissue and to assure accurate apposition of the mucosal edges, three sutures in the apex of the antral flap are placed in the manner described by Gambee.⁴ These key sutures are initiated by passing the needle through the full-thickness of the pedicle from serosa to mucosal surface. The needle is then passed out through the antral mucosa only. The stitch is completed by returning the needle into the lumen through the duodenal mucosa, and finally passing it out through the full thickness of the duodenal wall (Fig. 3). When the suture is tied, the mucosal and serosal surfaces of the pedicle are juxtaposed to their counterparts in the duodenum. Three such sutures are placed in the apex of the advanced antrum, securing it to the distal extent of the duodenal incision. The remainder of the closure is carried out with a single layer of interrupted full-thickness silk sutures. (Fig. 4)

Clinical Experience

Pedicle pyloroplasty has been employed in 33 infants and children. Thirteen of the patients were less than 6 months of age at the time of surgery. The indications for operation are shown in Table 2. Two patients had scar and inflammation in the anterior duodenum. A third had an anterior ulcer which had previously perforated but sealed against the gall bladder. The pedicle is an ideal

TABLE 2 *Clinical Experience with Y-U Advancement Pyloroplasty*

Hiatal Hernia or Gastroesophageal Reflux		21
A. Concomitant (for gastric stasis)	15	
B. Delayed (for persistent stasis)	4	
C. With vagotomy for severe esophagitis	2	
Peptic Ulcer		
With vagotomy		7
Esophageal Substitution		4
Revision of Obstructed Heineke-Mikulicz		1
Total		33

way to combine pyloroplasty with excision of the diseased anterior duodenum (Fig. 5). Excision of scar or ulcer and replacement with healthy antral tissue has offered a solid, pliable channel with no difficulty in healing at the duodenal margin. Of special note is an infant who

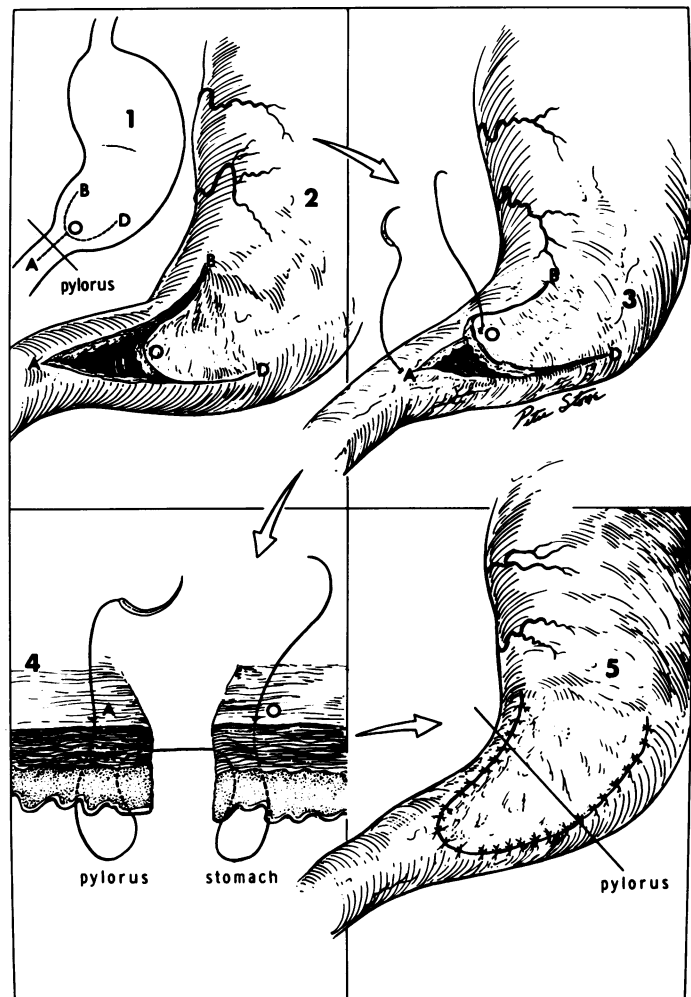


FIG. 3 Diagram depicting steps in the construction of Y-U advancement pyloroplasty. (1) Dotted lines indicate proposed incisions. (2) Line drawing showing completed incision of pedicle and incision in anterior duodenum. (3) Key suture to position antral pedicle in duodenal incision. (4) Diagram depicting Gambee Suture to insure mucosal apposition. (5) Completed pyloroplasty. Line indicates pylorus and demonstrates widening effect of the pedicle advanced.

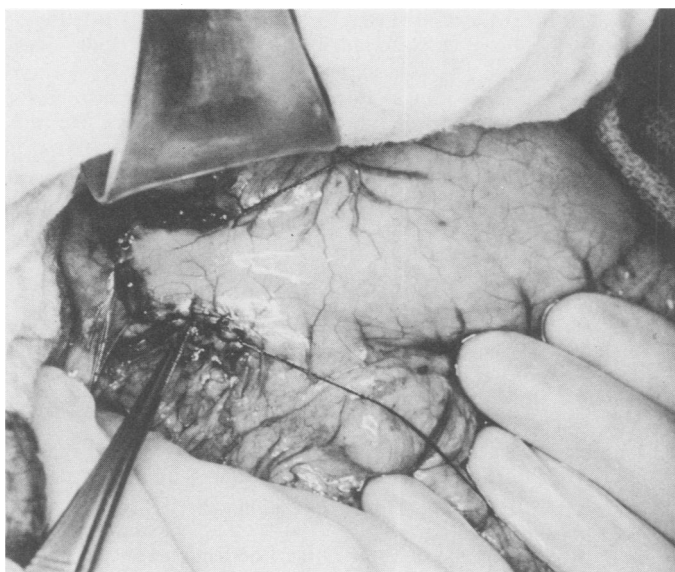


FIG. 4. Operative photograph of completed Y-U pyloroplasty in an infant. (Reprinted from J. Ped. Surg., 6:390, 1971)

had undergone Heinecke-Mikulicz pyloroplasty but was completely obstructed at the site of the previous operation. Conversion of this mechanical problem by using the Y-U operation was ideal and obviated the need for gastrojejunostomy (Fig. 6).

Pyloroplasty by advancement of the antral pedicle has proven to be structurally sound in pediatric patients. Operative time is short and there have been no significant postoperative complications. In all patients, gastric emptying has been prompt, as determined by postoperative barium studies. None of the patients have had subsequent clinical problems related to the pylorus, and there have been no late problems with respect to growth

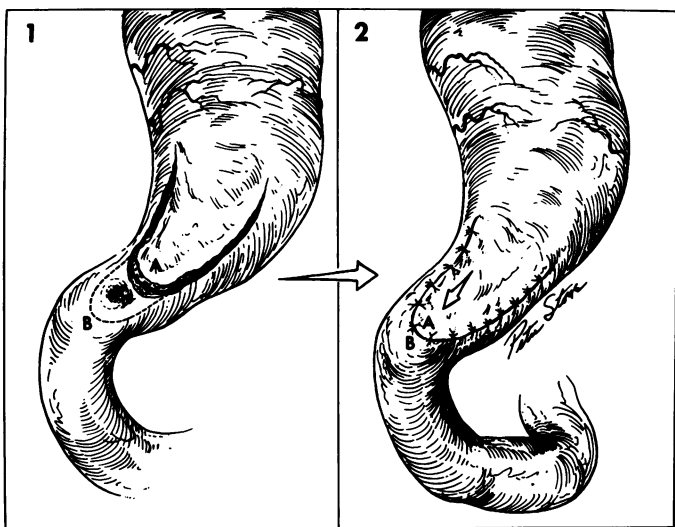


FIG. 5. Diagram showing excision of duodenal ulcer and replacement by antral pedicle.

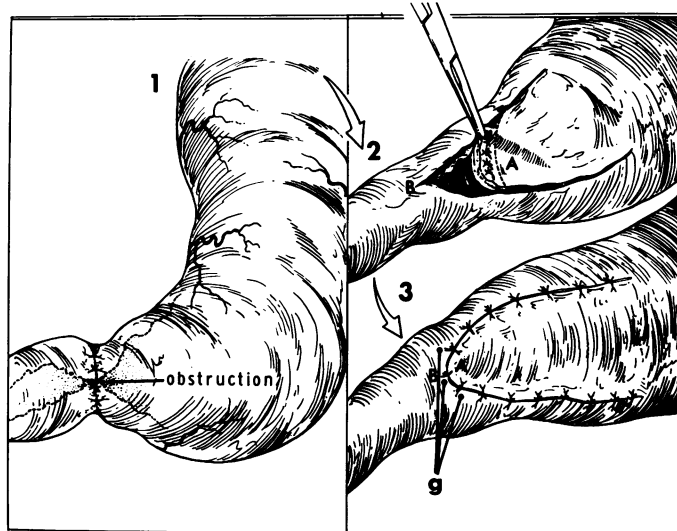


FIG. 6. Diagram showing use of antral pedicle to widen pylorus obstructed at site of previous Heinecke-Mikulicz operation.

of the stomach or pyloric canal in long term followup of these growing subjects.

Discussion

The studies of Sawyers and Scott,²¹ and Wise and Ballinger²⁴ underscore the fact the pyloroplasty will continue to be a useful component in the surgical treatment of peptic ulcer. This is especially true for children where pyloroplasty with vagotomy is recommended as the operation for the younger subjects^{10,22} because it produces the least anatomic derangement and the least disturbance of physiology. Pyloroplasty has also been used in infants as a complementary procedure in repair of hiatal hernia and gastroesophageal reflux.^{11,13} Some children with caustic strictures of the esophagus have had such extensive inflammation that vagal function has been impaired; for these patients pyloroplasty has been necessary to improve gastric emptying.

As in the adult, effective gastric emptying *via* an adequate lumen is the prime consideration of pyloroplasty in infants and children. There are additional unique demands of pyloroplasty in young patients. For example, it is highly desirable that the pylorus be open and functioning early in the postoperative course of the neonate. Operative time is another significant factor in the thermolabile infant, and thus the operative procedure must be simple in design. In small patients, the Heinecke-Mikulicz pyloroplasty sometimes fails to provide adequate gastric drainage because the internal diameter of the passage thus created may be no larger than the infant's uncorrected pylorus.

In an article supporting the Jabouley procedure, Hurwit and co-workers⁸ have cited some of the disadvantages of the pyloroplasty of Heinecke and Mikulicz. Ac-

According to these authors, the difficulty of performing the operation in an inflamed, scarred duodenum and the possibility of narrowing the pylorus by reduction of the AP diameter are serious detractors. Additionally, Ballinger and Solanki¹ have emphasized that the Heinecke-Mikulicz procedure suffers from distortion of the normal antral funnel and disruption of antral peristalsis. Those surgeons who have been concerned about the inadequacies of the Heinecke-Mikulicz procedure have generally resorted to the Jabouley or the Finney drainage procedures.⁶ The advantage of the excellent opening provided by the Finney pyloroplasty or the Jabouley gastroduodenostomy is offset in infants by the more extensive dissection and increased operative time required for its construction. Ballinger's suggestion¹ of widening the pylorus by a jejunal patch has certain mechanical advantages to recommend it. However, the same objective can be achieved by advancing the gastric pedicle which, in turn, creates a more anatomic funnel. This latter benefit has particular merit in young patients.

The theoretical objection of transposing gastric antrum into contact with the alkaline duodenal content, thereby stimulating gastric secretion, has not proven clinically significant. It is likely that most successful pyloroplasty procedures create a mixing chamber of gastric and duodenal content in the region of the pylorus.

This Y-U operation produces a wide pyloric channel without extensive dissection or prolonged operative time and these salutary features are particularly appealing in infants and children. Preservation of a neuromuscular funnel at the pylorus is suggested by fluoroscopic study of these patients. Its use in a patient who was obstructed after a Heinecke-Mikulicz pyloroplasty is another successful application of the procedure. An added dividend of the Y-U pyloroplasty, which may have special pertinence for adults, is its adaptability to patients with an acute ulcer or scar in the anterior duodenum.

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DISCUSSION

DR. GEORGE A. HIGGINS, JR. (Washington, D. C.): About two years ago one of the residents who had rotated through Dr. Randolph's service came onto our service and began talking about this "cool" method of doing a pyloroplasty.

We were working on patients at opposite ends of the chronologic

spectrum; but I went through my files and dug out a slide showing this technique which we had learned from Ben Walske, who was the co-author of the Moschel paper in 1958. We have used this on a number of occasions for pyloroplasty, and have found it to be quite satisfactory. So I can also commend it to you as another tool in your surgical armamentarium.