

# Jejunioleal Bypass

## Long-term Results

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Between October 1967 and November 1977, the jejunioleal bypass was performed on 177 patients for morbid exogenous obesity. The female-male ratio was 9:1. The mean follow-up period was 3.4 years and their ages ranged from 15 to 58 years. Eighty-five per cent of this patient population base were between the ages of 21 and 49 years, and in 83% the onset of obesity was in childhood. Four parameters were used to assess the effectiveness of this procedure: 1) the ponderal index, 2) the per cent of ideal weight, 3) complications, and 4) diarrhea. Using the ponderal index, 38% of the results were excellent, 20% satisfactory, and 25% poor. When the per cent of ideal weight was used, the results were 24, 27 and 32% respectively. For complications, the results were 55, 23 and 5% and with diarrhea, 53, 22 and 8%. A summary of these mean values was 42.5, 23 and 17.5% for excellent, satisfactory and poor results. There were four deaths in this series, occurring 2-16 months postoperatively, due to sepsis, pulmonary embolism, drug overdose, and liver failure. Of the 28 patients (17%) requiring revision, eight were revised for inadequate weight loss, four for excessive weight loss, 15 for uncontrollable diarrhea, and 11 for metabolic electrolyte problems. In 14% the revision was required for multiple indications. A review of 100 of these patients to determine their response to the procedure revealed that 91% were able to recommend the procedure to other patients and interpreted their results as being excellent in 51%, good in 36% and fair in 11%. Continued use of this procedure should be deferred pending much needed investigation of the associated complications.

SINCE KREMEN AND ASSOCIATES suggested, 25 years ago, that the absorptive surface of the small bowel be excluded as a method of treatment for exogenous obesity, numerous reports and innovative revisions have come forth in the evolutionary development of the jejunioleal bypass.<sup>5</sup> While this approach has not been proposed as the ultimate answer for obesity, in selected circumstances it is of value. Our experience with jejunioleal bypass on the surgical services of the Creighton University Affiliated Hos-

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pitals began approximately 12 years ago. It was the purpose of the initial phase of our study to critically develop our patient selection process, refine the operative technique to make it both safe and reproducible, and to develop an objective method of assessing our results.

The selection of candidates for this form of bariatric surgery underwent constant revision during the initial years of using this operation for exogenous obesity. Only those patients who fulfilled the definition for exogenous morbid obesity were considered, *i.e.*, those at least 100 pounds over the Metropolitan Life Insurance Height-Weight Tables<sup>7</sup> or if progressive weight gain continued despite attempts at conservative therapy we felt to be reasonably documented. Specific attention was devoted to confirming and reviewing those forms of dietary management under physician supervision. Our initial evaluation was designed to establish the presence or absence of a correctable endocrinopathy and to outline all risk factors applicable to each patient. It was our preference to have existing metabolic defects stabilized if at all possible prior to surgical intervention. A careful assessment was made of the patient's personality and particularly their willingness to delete alcohol as a part of their normal dietary or social life. The psychosocial stability of the patient was evaluated by the attending surgeon. Psychologic and psychiatric evaluation of these individuals was routine in the early phase of this study but later deleted. Following the initial interview and analysis of the accumulated biochemical data, an observation period of three months was interposed. During this period an additional dietary management trial was outlined and observed.

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Submitted for publication: December 11, 1979.

## Materials and Results

The clinical data base for this study consists of 177 patients operated between October 1967 and November 1977. One hundred fifty-eight patients (89%) were female and 19 (11%) were male, constituting a female-male ratio of 9:1. From this group the completed information on 163 patients was available for a crude follow-up rate of 92%. The mean follow-up period was 3.4 years, varying from one to 11 years. Their ages ranged from 15 to 58 years. In this group 9% of the patients were under 20 years of age, 85% were between the ages of 21 and 49 years, and 6% were over the age of 50. In 83% of the patients the onset of obesity was in childhood, in 12% of the patients the obesity developed in their 20s, and in 5% of the patients it was acquired after the age of 30. Eighteen per cent of the patients had a cholecystectomy prior to jejunioleal bypass, an additional 19% at the time of the procedure, and 5.5% after jejunioleal bypass. Fourteen per cent of the patients had ischemic electrocardiographic changes before the operation, 4% had prior urinary tract calculi, 6% of the females had a significant infertility problem, and 17% had had a previous hysterectomy. Fifteen per cent of the total group of patients were diabetic.

All patients were admitted to the hospital two days prior to the date the procedure was to be performed, placed on a mechanical bowel prep and in selected cases an antimicrobial prep was instituted. Considerable attention was directed preoperatively to instructions regarding postoperative pulmonary therapy. Details of the jejunioleal bypass have been adequately described elsewhere and will not be repeated here.<sup>1,4</sup> All patients in this series had an end-to-side 14-4 inch (jejunum to ileum) procedure without diversion of the distal ileum into the colon. Appropriate caution was taken in preparation of the skin, with meticulous wound closure, and thorough exploration of the abdomen. As part of our study, measurement of the total length of the small bowel was obtained. All mesenteric defects were closed following bowel anastomoses to avoid internal herniation. Care was taken to keep the entire small bowel either above or below the anastomosis. In the last three years we aggressively employed the TA-30 stapler, which allowed a reduction in operative and anesthesia time. Staples were helpful postoperatively in identifying the proximal jejunum which was anchored to the root of the mesentery. We have routinely performed an appendectomy to eliminate the necessity of a future laparotomy for acute appendicitis. Hemostasis, good exposure and meticulous operative technique are critically important. Retention sutures have been avoided and drains were seldom placed in the subcutaneous

space. When wound drainage was required the drains were removed in 24-48 hours. Improved postoperative pulmonary support has been a major contribution to these results.

## Evaluation

A prolonged review of numerous clinical methods of assessing the results of this procedure have been found ineffective and not truly representative of the condition of these patients. No single parameter was a reliable index of these results. We have, therefore, evaluated our patients using four parameters: 1) the ponderal index,<sup>9</sup> 2) the per cent of ideal weight obtained, 3) complications, and 4) diarrhea. Diarrhea was considered as a separate complication because of patient and surgeon awareness of this symptom complex.

### *The Ponderal Index*

The ponderal index is a method of determining the mortality ratio for a patient when given the height and weight. This formula is:

$$\text{P.I.} = \frac{H}{\sqrt{wt^3}}$$

*i.e.*, the height in inches is divided by the cube root of the weight in pounds. An inverse relationship exists between the ponderal index and mortality ratio. The higher the ponderal index the lower the mortality ratio. A ponderal index of 12.3 or higher results in a mortality ratio of 100% or better. It is not until the ponderal index is 11.6 or lower that the mortality ratio rises above 125% of normal, and at 11.2 a mortality ratio of 150% is reached<sup>9</sup> (Fig. 1).

Using the ponderal index we have classified our patients as follows: An excellent result is obtained if the ponderal index equals 11.7 or more; a satisfactory result exists when the ponderal index is between 11.6 and 11.2; and a poor result is obtained if the ponderal index is less than 11.2. By this categorization, 38% of our patients were in the excellent group, 20% were satisfactory, and 25% remained in the poor group (Table 1). In the total group the mean ponderal index was 10.06 preoperatively and 11.52 postoperatively. (Fig. 1—Ponderal Index) In this and subsequent evaluations 17% have required revision and are listed as initial failures.

### *The Per Cent of Ideal Weight*

The per cent of ideal weight is obtained from actuarial tables supplied by the insurance industry.<sup>7</sup> Employing this parameter we have grouped our pa-

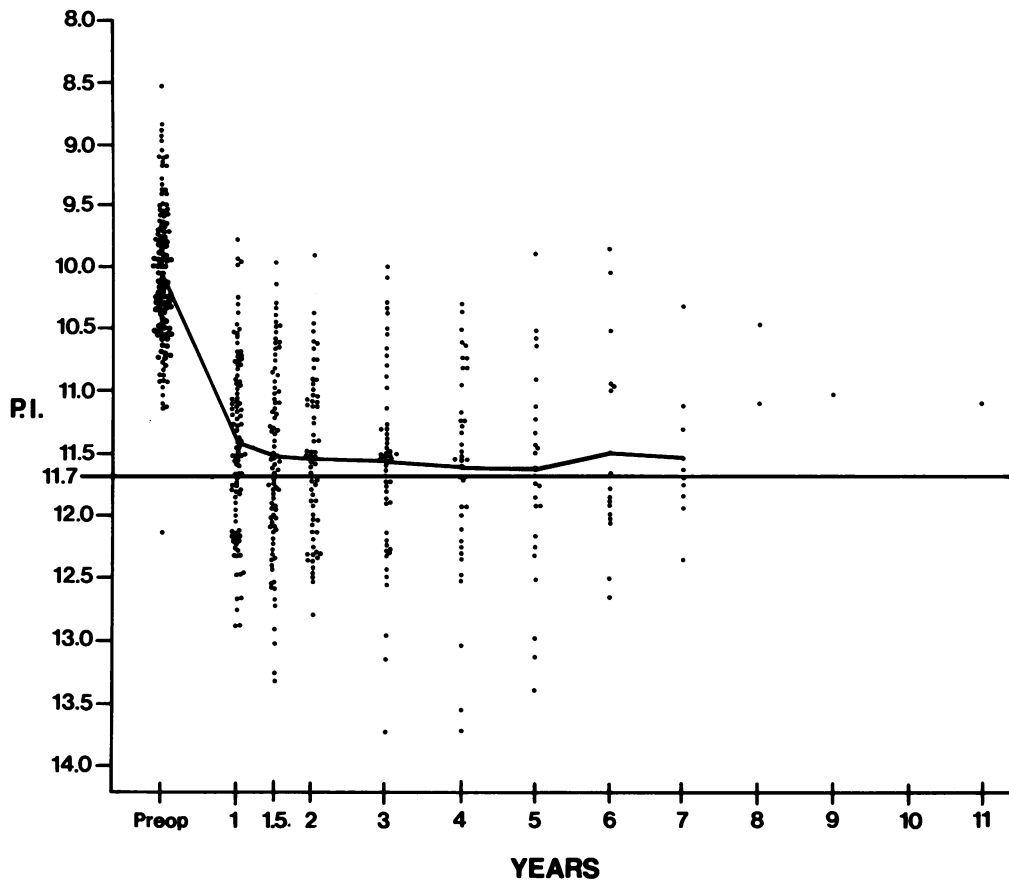


FIG. 1. Ponderal index.

tients in the following categories: 1) An excellent result exists for those who have maintained a weight of 125% of their ideal weight or less; 2) satisfactory if the patients have reached a weight of between 125 and 145% of their ideal weight; and 3) a poor result if their weight is in excess of 146% of their ideal weight. Using this more conventional method of evaluating the results of the jejunioileal bypass for morbid obesity, the mean preoperative weight in the total group was 215% of the ideal. Postoperatively, the mean per cent of ideal weight was reduced to 142% for a net reduction of 73% (Fig. 2). In assessing the per cent of ideal weight to interpret these results, 24% of our patients fell into the excellent group, 27% into the satisfactory group, and 32% obtained a poor result (Table 1).

TABLE 1. Analysis of Results

	Per Cent Excellent	Per Cent Satisfactory	Per Cent Poor	Per Cent Revisions
Ponderal index	38	20	25	17
Per cent ideal weight	24	27	32	17
Complications	55	23	5	17
Diarrhea	53	22	8	17
Summary of mean values	42.5	23	17.5	17

### Analysis of Complications

All complications encountered (excluding diarrhea, *i.e.*, anorectal lesions, systemic and metabolic complications (*i.e.*, arthritis, hair loss, urinary tract stones), have been included. Those patients without complications were assigned to the excellent group, the satisfactory group consists of one treatable complication, and in the poor group two or more complications. In the total series, 26.5% of the patients developed some significant abnormality during their postoperative course. From the viewpoint of complications, 55% of the patients fell into the excellent category, 23% were satisfactory, and 5% of the patients were placed in the poor group (Table 1). A summary of complications encountered postbypass is summarized in Table 2.

### Diarrhea

Those patients experiencing less than four stools per day requiring no antidiarrheal medications were determined to have an excellent result, those with four to six stools as satisfactory, and a poor result if individuals experienced six stools or more per day. Fifty-three, 22 and 8% of the patients were in the excellent, satisfactory and poor groups respectively (Table 1).

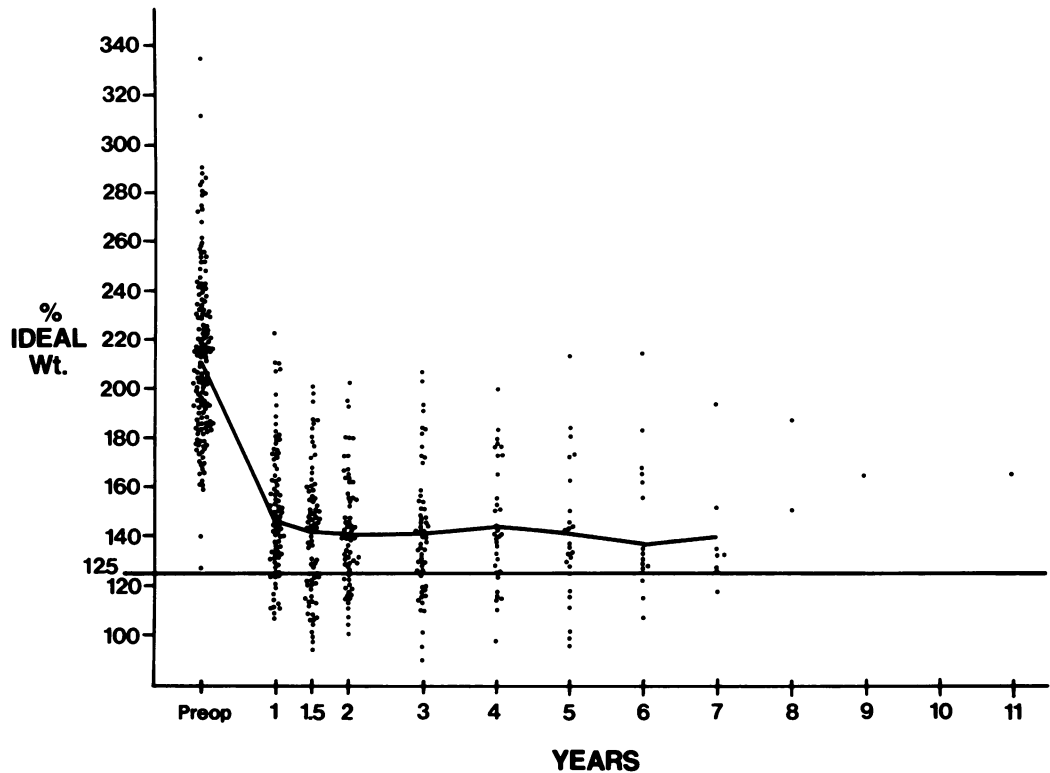


FIG. 2. Per cent ideal weight.

### Deaths

There were four deaths in this series of 177 patients for a mortality rate of 2.2%. The time of death varied from two months to 16 months postoperatively (Table 3). No deaths occurred intraoperatively or in the immediate 30-day period. Patient 1 was a 46-year-old, 385-pound woman who developed intraabdominal abscesses progressing to sepsis and renal failure. The patient died four months after the procedure. Patient 2 died 60 days after the bypass procedure, outside the hospital and in apparent good health, from a massive pulmonary embolus. Patient 3 died 16 months following surgery from a drug overdose outside of the hospital. Patient 4 had returned to work at a state mental hospital, following which she had acute liver failure secondary to infectious hepatitis and died two months postoperatively.

### Analysis of Patients Requiring Revision

The indications for bypass revision fell into the following categories: a) Those patients with inadequate

weight loss; b) excessive weight loss; c) uncontrollable diarrhea and associated severe anorectal problems; and d) those patients developing metabolic and/or electrolyte abnormalities. What options are available to the surgeon when single or multiple indications for revision exist? We have previously proposed the following options: 1) A return to normal intestinal continuity; 2) shortening of the existing bypass by resection of the jejunum, ileum or both; 3) conversion of an end-to-side to end-to-end anastomosis with diversion of the blind loop into the colon; 4) lengthening of the existing bypass; 5) conversion of a jejunoileal to a jejunoileal anastomosis; 6) conversion of an end-to-end to an end-to-side anastomosis; and 7) re-establishing normal gi continuity with gastric bypass substitution.<sup>3</sup>

What were the results using these indications for surgery? Twenty-eight of the 177 patients (17%) required some form of revision. The indications for these failures were a) inadequate weight loss (8 patients), b) excessive weight loss (4 patients), c) uncontrollable

TABLE 2. Complications Encountered Postbypass

Metabolic	26.5%
Rectal	13.0%
Urinary Tract Stones	8.0%
Arthritis	9.0%
Cholelithiasis	5.5%
Ventral Hernia	4.0%
Hair Loss	4.0%

TABLE 3. Summary of Deaths (2.2%)

Age/Sex	Preoperative Weight	Month Expired	Cause
46/F	385 lbs	4 months	Sepsis
45/M	325 lbs	2 months	Pulmonary embolism
20/F	426 lbs	16 months	Drug overdose
45/F	284 lbs	2 months	Liver failure

TABLE 4. Indications for Revisions (28 Patients—17%)

Inadequate weight loss	8
Excessive weight loss	4
Uncontrollable diarrhea	15
Metabolic/electrolyte problem	11
Total	38*

\* Fourteen per cent had multiple indications.

diarrhea (15 patients), and d) metabolic-electrolyte problems (11 patients). There were multiple indications in 14% of this group requiring revision. Most patients assumed a defeatist attitude and were quite certain their obesity would return if normal intestinal continuity was re-established (Table 4). There were 23 females and five males in this group. The earliest revision was performed eight months postoperatively, the longest at 80 months with a mean of 35 months. The revision procedures employed were as follows: a return to normal intestinal continuity in two, one was shortened, 12 were lengthened, three were converted from end-to-side to end-to-end with the distal ileum being placed into the right colon and nine patients were converted to a gastric bypass (Table 5). The success rate experienced with these revisions was 70% (20 patients).

There exists among physicians an impatience and aggressiveness to revise the jejunioleal bypass when careful nutritional evaluation and treatment will produce satisfactory results. Only one-third of those patients referred to us for revision (not part of this data base) necessitated operative intervention.

#### Patient Response to Jejunioleal Bypass

Considerable attention has been devoted to the anatomic, physiologic, biochemical and other objective parameters in determining the success of this procedure. Minimal attention has been directed toward the patient's reaction to this radical but unique approach to the control of morbid obesity. One hundred patients from the total series who had undergone jejunioleal bypass have been interviewed. The accumulated data was sufficient in 97 patients for a thorough evaluation during a follow-up period that ranged in this subgroup from six months to five years with a mean of 3.4 years. A questionnaire, telephone call or personal interview by a registered nurse from our clinic was employed to contact these patients. The average weight loss was 84 pounds (38 kg). There was a dramatic reduction in dress or pant size during the period of initial follow-up. Sixty-one per cent observed a marked decrease in appetite following the procedure and 81% believed the ensuing weight loss significantly affected their outlook on life. The husband, wife or "close companion" was pleased in 83% of the cases. Ninety-

one per cent of the patients felt able to recommend this procedure to someone else. These patients interpreted their own results as being excellent in 51%, good in 36% and fair in 11%. The interpretation of these results must be viewed within the context of the general unreliability of the patients when they discuss dietary matters.

#### Discussion

Dietary restrictions, the ideal treatment for exogenous obesity, has long been known of but seldom tried. The ideal bariatric surgical procedure 1) should be technically uncomplicated; 2) should avoid: a) severe electrolyte and nutritional problems, b) rapid gastrointestinal transit time, c) single and/or multiple organ failure, d) intussusception of the blind jejunal loop, e) the blind loop syndrome; 3) allow for controlled weight reduction; and 4) be a reversible procedure.<sup>3</sup> None of the current surgical procedures meet all of these requirements.<sup>2,6,8,10,13</sup>

As one would expect, the indications for this procedure as well as technical variations have evolved rapidly during the last 15 years. Seldom has a model as unique as jejunioleal bypass been designed and made available for clinical investigation. In altering the anatomic and physiologic properties of small bowel, it is unrealistic to expect these patients to return to normalcy. The criticism jejunioleal bypass is undergoing following an initial period of enthusiasm seems warranted. This detailed review of our results will not counteract this wave of criticism but represents a planned effort to share these experiences with our colleagues. We have deliberately avoided comparing this procedure with gastric bypass which stands on its own merits.<sup>11</sup> The multiple parameters used to evaluate our results and a review of the patient response is significant and critical to understanding the status of this procedure. Clearly, when the Ponderal Index was the assessment parameter 42% experienced poor results or required revision; 49% when the per cent ideal weight was the index; 22% had poor results or demanded revision when complications alone were considered and 25% if diarrhea was the index of assessment. A summary of the mean values of these groups reveal the results to be 42.5% of the patients in the ex-

TABLE 5. Procedures for Revisions

Return to normal intestinal continuity	2
Shortening of the Bypass	1
Lengthening of the Bypass	12
Conversion of j-colic to j-ileal	0
Conversion of End/Side to End/End	4
Conversion of End/End to End/Side	0
Conversion to Gastric Bypass	9

cellent group, 23% of the patients were satisfactory and 17.5% poor, with 17% of the patients requiring revision and representing initial failures (Table 1).

We were aware early in this experience of the problems faced by women in the child-bearing age group who were taking oral contraceptives for birth control purposes. It became a mandatory part of our informed consent to apprise them that following this procedure, in light of the information currently available, they should not rely on this method of birth control. Accurate absorption studies of the oral form(s) of these agents in this group of patients has proven to be helpful and supportive information.<sup>12</sup> This directly focuses attention on the wide range of problems encountered in this same group when required to take oral medications, *i.e.*, antibiotics, cardiac medications, maintenance drugs, etc. Eleven pregnancies occurred in nine patients following jejunioleal bypass. All deliveries and infants were normal except for one stillborn, not thought to be related to the bypass procedure itself or any metabolic complication that might have developed.

Fifteen per cent of the patients in this group were known diabetics prior to jejunioleal bypass. Their insulin requirements were dramatically reduced following the procedure. We prematurely and incorrectly correlated this phenomenon with the associated rapid weight loss. It became apparent that this occurred early in the immediate postsurgical period prior to any significant weight reduction. In 12 of 15 patients the insulin requirements were significantly reduced and in some patients neither insulin or dietary restriction were required. A thorough study of carbohydrate metabolism and insulin requirements in the intestinal bypass patient should prove illuminating. The potential use of this procedure in carefully selected diabetics following time-honored experimental studies will warrant serious consideration.

In the total series of 177 patients, we treated ten patients under the age of 18. Their results were parallel to those experienced in the adult population. Our lack of knowledge about the long-term effects of jejunioleal bypass prompted us to be conservative in the "under 20" age group. We wished to avoid substituting a set of metabolic complications worse than those secondary to exogenous obesity. To date we have observed no adverse effects in this young age group up to eight years following bypass.

The majority of the complications occurred during the first year and most patients reached a plateau in their weight reduction by 18 months. The response within each set was varied and unpredictable. It became increasingly difficult to predict in advance the

type of result obtained. These patients demand considerable time postoperatively in terms of reassurance, specific dietary and medication adjustments and rehabilitation exercises. Their interface with other bypass patients either on a personal basis or as a group has proven beneficial. A drastic difference obviously exists between patient interpretation of the result and our objective assessment.

A failure rate of 17% is unacceptable. The elimination of major problems precipitated by this controlled short bowel syndrome must be corrected. In the immediate future intestinal bypass should preferably be performed in an institutional setting where these patients can be afforded the benefit of detailed follow-up and study. To improve these results a moratorium should be declared on the jejunioleal bypass to allow this procedure to be restudied in research laboratories throughout the world. Alterations can then be instituted and if warranted a new clinical study can be undertaken. The small bowel continues to be a fertile field for research. Fundamental investigative work is needed to more fully understand the complications of oxalate stone formation, hypopotassemia, diarrhea, drug absorption in the intestinal tract, intestinal mucosal changes, hepatic dysfunction, and alterations in carbohydrate metabolism.

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