Laparoscopic Roux-en-Y Gastric Bypass for Morbid Obesity

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1.0 Introduction

Taking into account the total number of afflicted individuals, obesity constitutes a significant disorder in Germany. Until recently, however, only minor attention has been given to this disease. The prevalence of obesity is on the rise in all industrialized nations, and in Germany an estimated 10-20% (depending on the definition used) of all school children and adolescents are obese. Another apparent trend is an increase in the degree of obesity, such that there has been a substantial gain in the number of extremely obese individuals. This phenomenon can be attributed to multiple factors, including changing lifestyle habits (excessive intake of food rich in calories / fat and lack of physical activity) which interact with genetic predispositions and thus lead to an increase in the body's fat content.

Accordingly, the objectives of obesity therapy are as follows:

- Reduction of energy intake,
- Increase in the patient's energy output,
- and thus help the body to achieve a new energy balance.

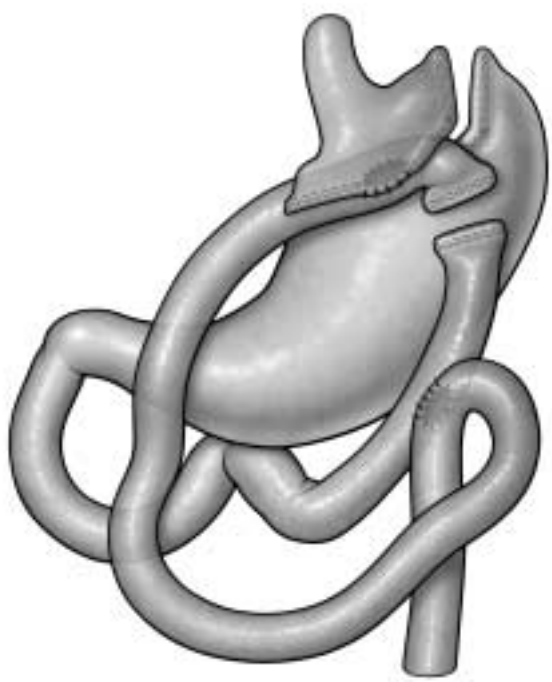
To date, obesity is recognized as a chronic disease rather than a biological variant. Obesity and its sequelae account for approximately 280,000 deaths year in the US alone, making this ailment the second most common cause of death in adults – trailing only smoking *(McGinnis* and *Foege*, 1993).

According to a 1993 German study sponsored by the Germany Federal Ministry of Health, approximately DEM 850 million in healthcare costs were related to obesity alone, without the relevant comorbidities. This is a very low estimate of the true burden on the national economy since the comorbidities of obesity are unaccounted for, and obesity is diagnosed only rarely in the normal clinical practice.

Obese people are also much more likely to utilize outpatient and inpatient resources and need more medication than individuals of normal weight, which produces substantially higher healthcare costs.

On behalf of the German Federal Ministry of Health, the research institute Infratest ascertained the overall costs of obesity and its comorbidities in Germany. When they performed a cost analysis of diet-related diseases and extrapolated the results to the year 1995, the researchers found that obesity-related costs accounted for approximately 5.4% of the total healthcare costs in Germany, or DEM 20.7 billion.

Similar calculations of obesity-related costs in other Western countries are consistent with the findings of the German study and demonstrate that obesity accounts for 2% to 8% of the total healthcare costs in these countries.



The classical Roux-en-Y gastric bypass.

What are the costs of overweight and obesity in the US?		
Total costs: $ 99.2 billion per year in the US.	**Direct costs:** $ 51.6 billion per year (5.7 % of the total US healthcare costs per year).	**Indirect costs:** $ 47.6 billion (comparable to the total US healthcare costs per year related to cigarette smoking).
Itemization of costs of concomitant and secondary disease due to overweight and obesity	**Direct costs:**	**Indirect costs:**
Costs of **cardiovascular disease** due to overweight and obesity.	$ 6.99 billion (= 17 % of $ 40.4 billion in total costs of cardiovascular disease, excluding myocardial infarction)	
Costs of **type 2 diabetes mellitus** due to overweight and obesity.	$ 63.14 billion (more than 60 % of the total costs due to type 2 diabetes mellitus)	
Costs of **osteoarthritis** due to overweight and obesity. Total costs: $ 17.2 billion	$ 4.3 billion	$ 12.9 billion
Costs of **arterial hypertension** due to overweight and obesity:	$ 3.23 billion (17% of the total costs related to hypertension)	
Costs of **carcinomas** due to overweight and obesity		
Post-menopausal breast cancer Total costs due to overweight and obesity: $ 2.32 billion	$ 840 million	$ 1.48 billion
Endometrial cancer Total costs due to overweight and obesity: $ 790 billion	$ 286 billion	$ 504 billion
Colon cancer Total costs due to overweight and obesity: $ 2.78 billion	$ 1 billion	$ 1.78 billion
Annual costs related to **loss of productivity** due to overweight and obesity in the US population (17–64 years of age)	$ 3.93 billion annually	

Comorbidities:

Obesity is considered to be causative for the following sequelae:

- Diabetes mellitus
- Cardiovascular disease
- Cerebrovascular stroke
- Hypertension
- Gall bladder disease
- Osteoarthritis (Degenerative bone disease)
- Sleep apnea syndrome
- Cancer (uterine, breast, colorectal, kidney and gall bladder)

Obesity is a contributing factor for the following:

- Hypercholesterolemia
- Pregnancy complications
- Menstrual disturbances
- Hirsutism
- Urinary stress incontinence
- Mental disease, and

Historically, all conservative attempts at treating morbid obesity (defined as a BMI >40 kg/m2) by administration of medication and other non-surgical methods have produced only minor or transient effects. As a result, bariatric surgery has gained widespread acceptance during the past 10 years due to its superior outcomes.

The criteria for any highly elective bariatric operation were established some 20 years ago: *effectiveness and safety of the method, long-term stability, and minimal adverse effects.* Numerous surgical procedures were initially attempted and later abandoned because they were either ineffective or produced too many complications; this was particularly the case with the various intestinal bypass procedures, such as the jejuno-colic and the jejuno-ileal bypass.

The Roux-en-Y gastric bypass became established in the 1980s and 90s, mainly in the United States and Southern Europe. In 1991, the *National Institutes of Health (NIH) Consensus Development Conference* recommended the Roux-en-Y gastric bypass and vertical gastroplasty as the only available surgical procedures for obesity that have continued beyond the developmental phase. Gastric bypass procedures are currently considered to be the gold standard for bariatric surgery in the United States. However, the rise in the number of laparoscopic duodenal switch operations indicates that this procedure has the potential of becoming an alternative option for gastric bypass operations.

1.1 Operative Procedures in Bariatric Surgery

Current surgical procedures are based upon three different therapeutic approaches:

1. **Gastric restrictive procedures**
2. **Gastric mixed procedures: restrictive and malabsorptive**
3. **Malabsorptive procedures.**

In our experience gastric bypass procedures generate beneficial results in terms of weight reduction and improvement in the quality of life.

The most important of these procedures are listed as follows:

- Jejuno-ileal bypass (in our mind, obsolete)
- Side-to-end anastomosis Roux-en-Y gastric bypass
- Original retrocolic loop gastric bypass according to Mason (in our mind, obsolete)
- Biliopancreatic diversion
- Vertical banded gastric bypass
- Gastric banding
- Vertical banded gastroplasty
- Horizontal banded gastroplasty
- Gastric pacemaker (strictly experimental)

1.2 Indications for Surgery

According to internationally accepted criteria (**Tab. 1**), the indications for bariatric surgery are a BMI >40 kg/m (in exceptional cases: BMI >35 kg/m^2 with pronounced comorbidity). The *National Institutes of Health (NIH)* criteria of 1991 also stipulate several failed non-surgical attempts at weight reduction under the guidance of a physician over a period of two or more years, the absence of surgical contraindications or concomitant disease, the approval of the health insurance carrier for covering the costs, and the patient's written informed consent. Nevertheless, limits to the indication for surgery continue to be the subject of active discussion. For example, diabetes specialists suggest a BMI level of 32 kg/m^2 in patients with type 2 diabetes as an indication for surgery.

The general exclusion criteria involve organ-related causes of obesity (endocrine disease), severe mental disorders (schizophrenia, florid drug addiction or severe depression), severe concomitant disease (tumors), patients under 18 or over 65 years of age, and an increased surgical risk (relative contraindications).

Indications for surgery *(according to I.F.S.O.)*
BMI > 40 for more than 3 years. Conservative therapy – preferably under the guidance of a physician or self-help group – has failed or showed only transient success.
Exclusion of endocrine causes, alcohol or drug abuse.
Severe metabolic disease, such as metabolic syndrome or sleep apnea syndrome associated with an urgent need for weight reduction, thereby corroborating the suggested indication for surgery.
Under normal circumstances, endogenous depression should be considered a contraindication for the surgical approach. This is in contrast to reactive depressions such as schizophrenia, florid drug addiction or severe depression.
As a matter of principal, surgical procedures for the purpose of weight reduction should not be undertaken in individuals under the age of 18 (exception: consent of a multidisciplinary team)

Tab. 1:
Criteria for surgery for the purpose of weight reduction as defined by the *"International Federation for Surgery of Obesity (I.F.S.O.)"*

The overweight and obese classifications are defined by the BMI formula as follows **(Tab. 2):**

$$\text{BMI} = \frac{\text{Body weight kg}}{\text{Height (m)}^2}$$

BMI kg/(m)^2	
Underweight	< 18,5
Normal weight	18.5 — 24.9
Overweight	25.0 — 29.9
Stage I obesity	30.0 — 34.9
Stage II obesity	35.0 — 39.9
Stage III extreme obesity	> 40

Tab. 2:
Classification of body weight by body mass index (BMI) according to *"WHO Expert Committee on Physical Status: The Use and Interpretation of Anthropometry"*.

2.0 Historical Background of the Roux-en-Y Gastric Bypass

In the mid-1960s, Mason observed that the Billroth II gastric resection and gastrectomy were often associated with a loss in body weight. This prompted Mason to develop the currently obsolete retrocolic loop gastric bypass. The technique created a small gastric pouch, which would quickly lead to the sensation of satiety and "dumping" symptoms after the intake of too many sweets.

Alden simplified the operation by stapling the stomach crosswise and anastomosing it with a jejunal limb in the antecolic position. *Griffen* later modified this procedure and generated an anastomosis of the jejunum in a higher position through the use of a retrocolic Roux-en-Y limb.

Bariatric surgery always involves a high degree of uncertainty and risk regardless of the procedure applied. Multiple factors contribute to the high morbidity of extremely obese patients. It is mandatory that preoperative risk evaluation be undertaken prior to scheduling any surgery. Adequate preoperative assessment and a minimally invasive surgical technique can minimize postoperative complications, especially pulmonary complications.

In general, the introduction of laparoscopic techniques has led to a broader implementation of bariatric surgery and improved patient compliance. Today's surgical procedures differ in their therapeutic approaches and can be divided into restrictive, malabsorptive, and mixed procedures.

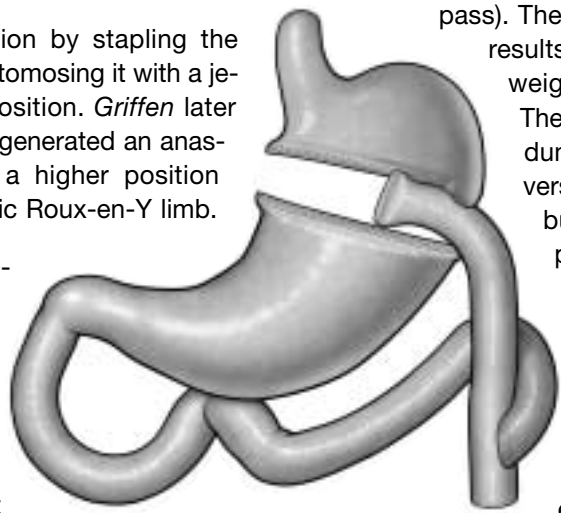


Fig. 1:
Schematic drawing of the Roux-en-Y gastric bypass.

3.0 Laparoscopic Roux-en-Y Gastric Bypass

The laparoscopic Roux-en-Y gastric bypass is a combined procedure where restriction is complemented by a malabsorptive component. The size of the pouch and length of the intestinal limbs continue to be the subject of active discussion. Proper performance of a laparoscopic gastric bypass (**LGB**) is a challenge for any surgeon. The usual abbreviation in the literature is **LRYGBP** (for **L**aparoscopic **R**oux-en-**Y** **G**astric **B**ypass). The procedure produces convincing results both in terms of reducing body weight and improving quality of life. The most common side effect is the dumping syndrome, which may adversely affect the patient's well being but does not manifest itself in all patients.

Since gastric bypass procedures are considered the gold standard for bariatric surgery in the United States, the number of laparoscopic gastric bypass operations can be expected to increase rapidly.

In 1994, *Wittgrove* was the first to perform the procedure using a laparoscopic approach. He has subsequently performed more than 1,000 procedures. In the US, the number of procedures continues to rise dramatically. Some published studies involve patient groups encompassing more than 1,000 laparoscopic operations per center. Although the weight reduction results are convincing, the consecutive complications may be more serious and the learning phase significantly longer than laparoscopic gastric banding. Laparoscopic conversion surgery after a gastric bypass is a rare occurrence.

4.0 Technique

The patient is placed in the reversed Trendelenburg position on an operating table approved for the patient's body weight. Video monitors are positioned on the right and left side, above the patient's shoulders. Both arms are placed in a stretched-out position (**Fig. 3a**). A transurethral urinary catheter is placed, and the surgical site is disinfected repeatedly. Cephalosporin is given for antibiotic prophylaxis.

Using a threaded TERNAMIAN EndoTIP® trocar cannula (KARL STORZ, **Fig. 2**), the pneumoperitoneum is established in the left hypogastric fossa until intraabdominal pressure is at 15 mmHg.

Fig. 2
A TERNAMIAN EndoTIP® trocar cannula (KARL STORZ) is used to establish the pneumoperitoneum safely.

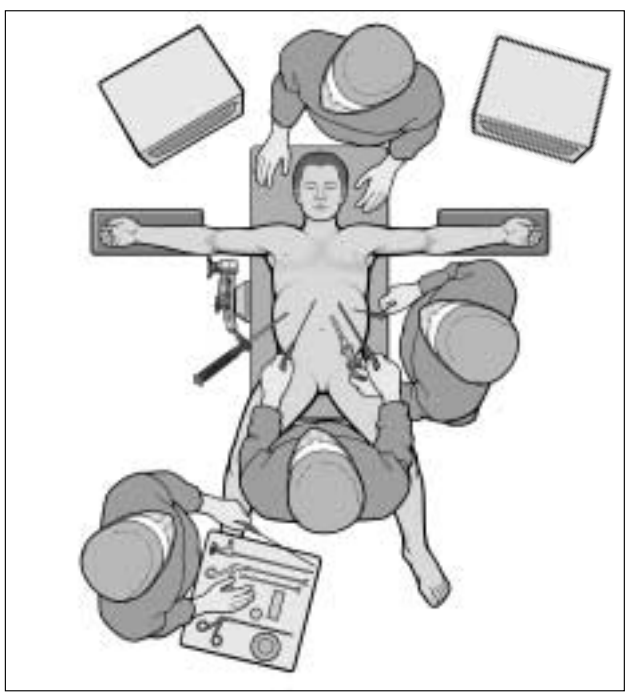


Fig. 3a
Patient positioning and working positions of the surgery team in the laparoscopic gastric bypass operation.

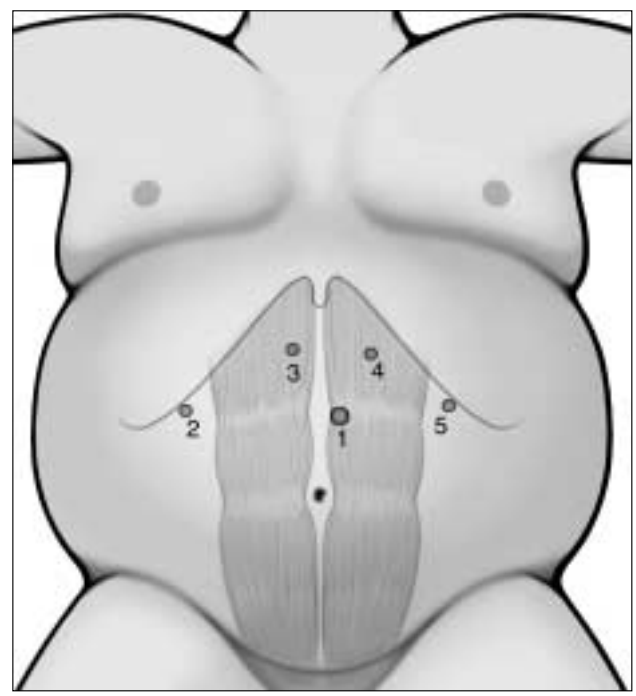


Fig. 3b

1) The rigid HOPKINS® rod-lens telescope (available in different directions of view) is coupled to the endoscopic camera system.

2) Right upper quadrant port for retracting the left lobe of the liver with the liver retractor.

3) Epigastrium above the left hepatic lobe in the direction of the right costal arch (port for operating instruments).

4) Similar to position 3, except that it points towards the left costal arch and maintains a minimum distance of at least 10 cm (port for operating instruments).

5) Below the costal arch (port for operating instruments, e.g. a Babcock grasper for holding the stomach).

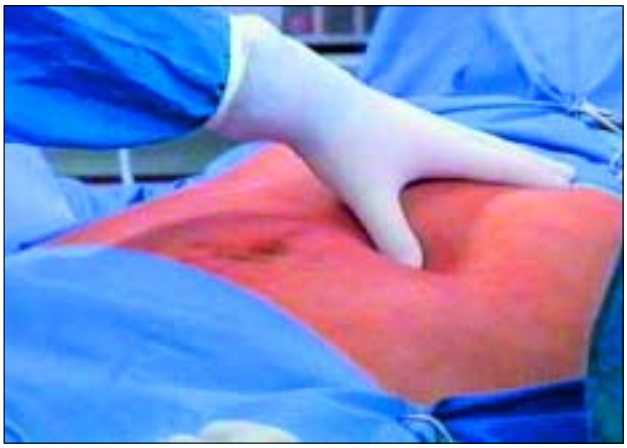


Fig. 4
The first trocar is placed in the upper abdomen about one forefinger-thumb length from the xyphoid.

It is essential that there be sufficient free space in the cranial position to permit free access to the gastroenteral anastomosis. Accordingly, the initial port should be placed at an approximate distance from the xyphoid that corresponds to the distance between the index finger and the thumb (**Fig. 4**). The 15 cm (extra long) trocar is especially well suited for use in patients with a BMI > 50.

The other trocars (**Fig. 2b,** p. 11) are then placed successively. Once the camera trocar port is established, an 11 mm trocar for insertion of the liver retractor is placed below the right costal arch. The liver retractor is then securely attached to an instrument holder and can be used to elevate the greater omentum. Subsequently, a 13 mm trocar is placed at the lateral abdominal wall below the left costal arch. The two epigastric working trocars (13 mm) are inserted such that they provide an optimal working angle for surgical maneuvers in the area of the hiatus. The distance between the working trocars should be large enough to avoid any obstructions.

Usually, HOPKINS® rod-lens telescopes with 30° and 45° directions of view are inserted. The use of extra long telescopes (42 cm) and extra long instruments (43 cm) can be an advantage, particularly in obese men.

Where the anastomosis between the gastric pouch and the jejunal limb is to be carried out with a circular stapler, the use of two gas insufflation units is recommended for adequate compensation of the gas loss often associated with this technique.

Figs. 5a, b
Use of the liver retractor in laparoscopic bariatric surgery.

In the event of gas loss, the high weight of the abdominal walls jeopardizes the continuation of the laparoscopic procedure. After insertion of the 11-mm trocar, the abdominal cavity is inspected with a 30° telescope. The other 13 mm trocars (for linear staplers) are inserted under constant endoscopic control.

The hiatal region is exposed using the liver retractor, which is securely attached to the instrument holder. Due to the frequent presence of hepatic steatosis, sturdy and extra long retractors must be used in this step. The authors prefer the use of retractor 30623 UR, (KARL STORZ) because of its large and atraumatic contact surface (**Figs. 5a, 5b**).

Once inspection of the abdomen is completed, the hiatus and cardia are exposed. The anatomical landmarks, such as the caudate lobe on the left side of the liver, the right diaphragmatic crus, and the angle of His, are then identified. Dissection commences at the angle of His such that this structure is mobilized. The cranial vasa brevia are transected using an ultrasonic dissector. The left diaphragmatic crus is then exposed, enabling subsequent completion of the pouch at the angle of His. Next, the lesser gastric curvature is dissected approx. 2 cm distal from the gastroesophageal junction and extended into the omental bursa using the ultrasonic dissector under constant endoscopic vision. Usually, the adequate dissection site is located proximal or distal to a large prominent vein running parallel to a side branch of the sinistral gastric artery across the anterior gastric wall. Dissection may be associated with some minor hemorrhage.

The stomach is completely transected using multiple cartridges of a linear cutter-stapler (length 45 mm, 3.5 mm staples, **Fig. 6**) creating a proximal gastric pouch, which should only have a small lumen. Currently, the preferred volume ranges between 25 and 90 ml. A nasogastric tube with a balloon tip can be useful during this step.

Fig. 6
Creation of a gastric pouch (schematic drawing).

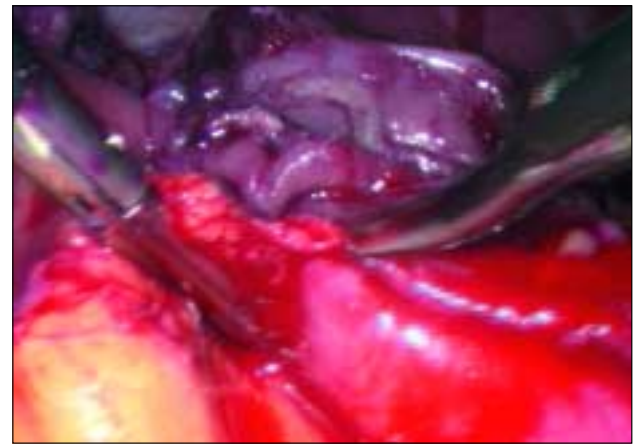


Fig. 7
Do not use electrocautery to stop intraoperative bleeding from the staple line. Oversewing of the staple line or clip application are more reliable methods.

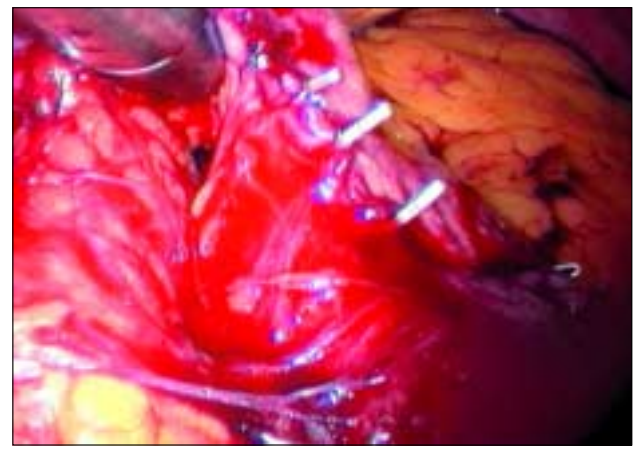


Fig. 8
Temporary clip application to stop spurting hemorrhage.

Intraoperative hemorrhage from the staple line is frequent, but hemostasis **must not** be provided by electrocautery (**Fig. 7**) since this may induce delayed necrosis. Clips can be applied for temporary management of spurting vessels (**Fig. 8**). Smooth and clean resection margins are optimal for anastomosis (**Fig. 10**, p.14).

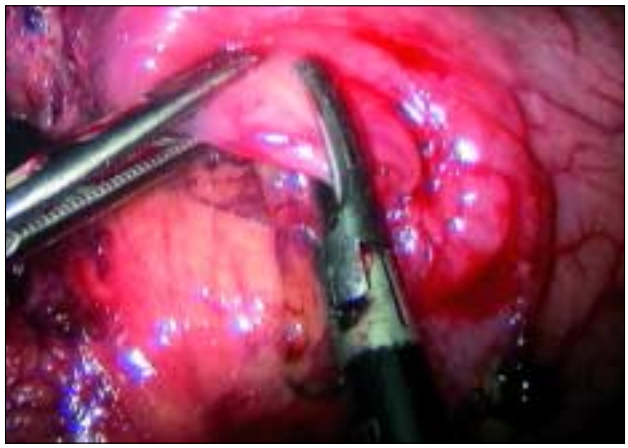


Fig. 9
Determination of the dissection plane in the area of the lesser curvature.

Fig. 11
Formation of a retrogastric tunnel for insertion of the linear stapler.

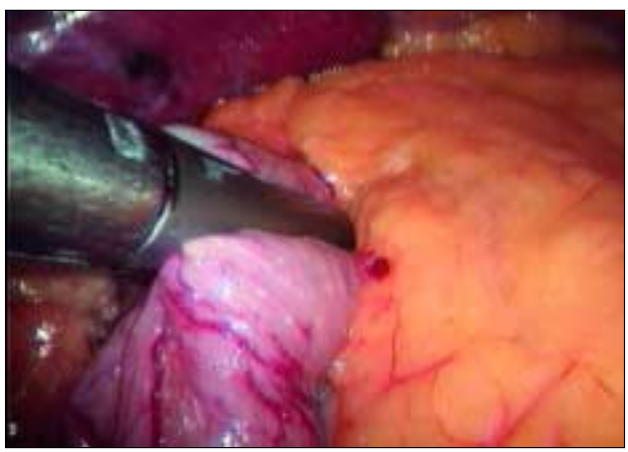


Fig. 12
Transverse resection of the stomach with a linear stapler.

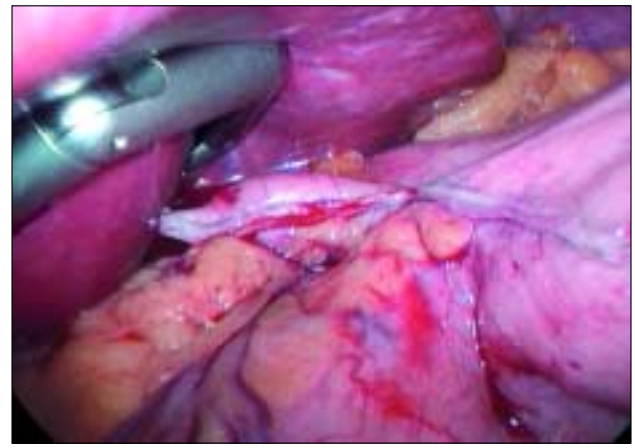


Fig. 10
Creation of the stomach pouch should be performed with a clearly defined resection line.

In general, there is a risk of the staple line opening partially and forming a suture dehiscence with restoration of the continuity of the pouch and remainder of the stomach. Consequently, some surgeons advise complete transection of the tissue between the staple lines to separate the pouch completely from the distal portion of the stomach. This also prolongs the duration of the surgery, increases the complexity of the procedure and may occasionally entail the formation of gastrogastric fistulas. It is likely that these fistulas are causative for insufficiencies in the pouch's staple line draining into the distal stomach. Continuous over-and-over suture can minimize the risk of staple line dehiscences.

4.1 Gastrojejunostomy

With the transverse colon in a turned-up position, a suitable small intestinal limb is chosen for connection to the abdomen without tension. For this purpose, the greater omentum should be transected to reduce tension (**Figs. 13, 15 – 18b**). As a rule, the lowest point of this limb resides approx. 50 cm from the ligament of Treitz (**Fig. 19**). The proximal portion is marked by clip application and the jejunum is then transected with a cutting stapler (**Fig. 20**). Prior to this step, the mesentery is skeletonized using the ultrasonic dissector.

The oral and the aboral limbs must be identified unambiguously. After correct identification, the oral limb is grasped and marked (e.g., with a marking suture or by clip application) to ensure the surgeon does not lose orientation in the further course of the procedure. The consequences of any mishaps would be disastrous.

There are two general types of gastrojejunostomy:
1. Antecolic (preferred by the authors), and
2. Retrocolic.

In terms of technique, the following types of anastomoses can be distinguished:
1. Circular end-to-end anastomosis stapling technique (EEA).
2. Linear end-to-end anastomosis stapling technique (for a schematic drawing of this technique, see **Fig. 14**).
3. “Hand-sewn” anastomosis.

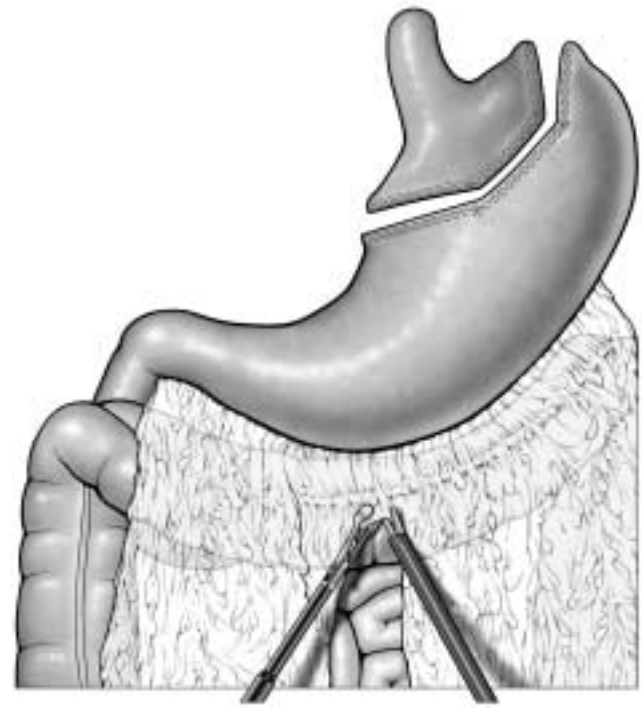


Fig. 13
Basic principle of omentum majus transection.

Fig.14
Basic principle of the linear end-to-end anastomosis stapling technique (posterior wall).

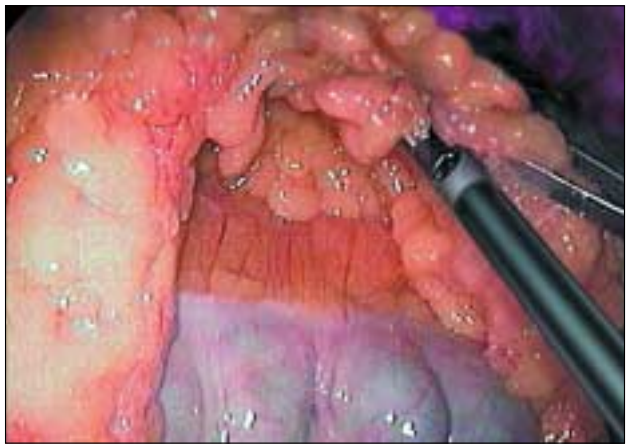


Fig. 15
The greater omentum is passed to the upper abdomen and transected using an ultrasonic dissector.

Fig. 16
Identification of the oral jejunal limb at Treitz's ligament.

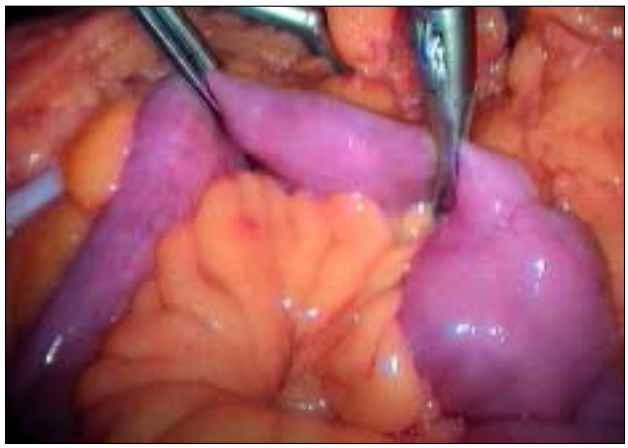


Fig. 17
Measuring the size of the jejunal limb is initiated at Treitz's ligament.

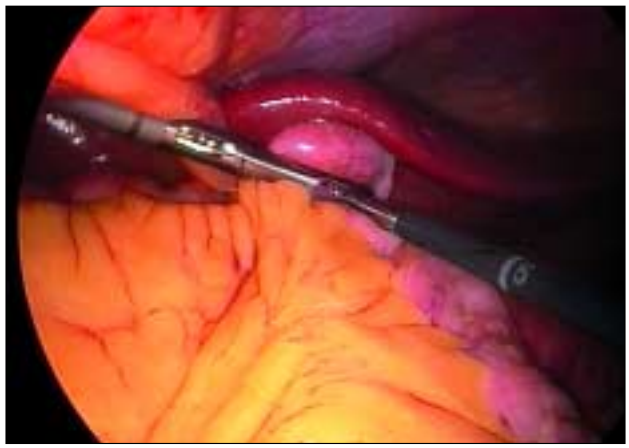


Fig. 18a
The distance markers on the forceps (in cm-steps) facilitate measurement of the correct length of the limb.

Fig. 18b
The distance markers on the forceps (in cm-steps) not only allow for measuring the length of the alimentary limb (starting at the gastro-jejunostomy), but also add precision to this important step of the procedure.

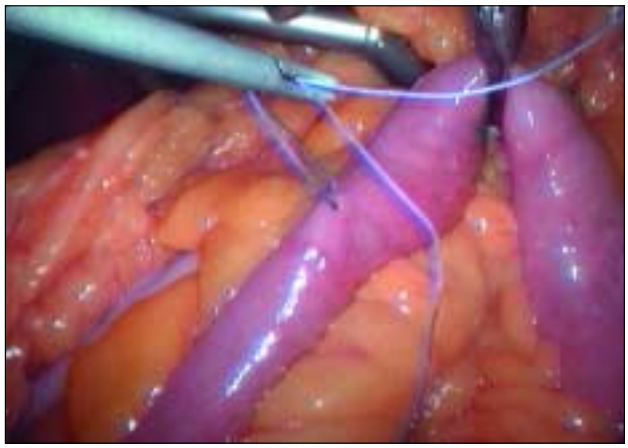


Fig.19
The small intestinal limb is measured and marked with a suture (50 cm from Treitz's ligament).

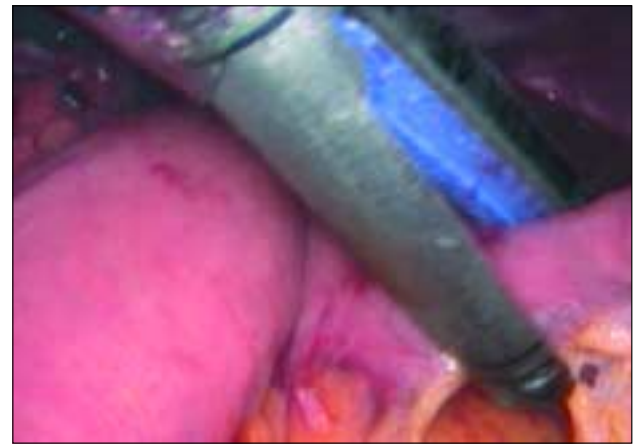


Fig. 20
Transection of the jejunal limb at a point distant enough so the pouch can be reached without tension.

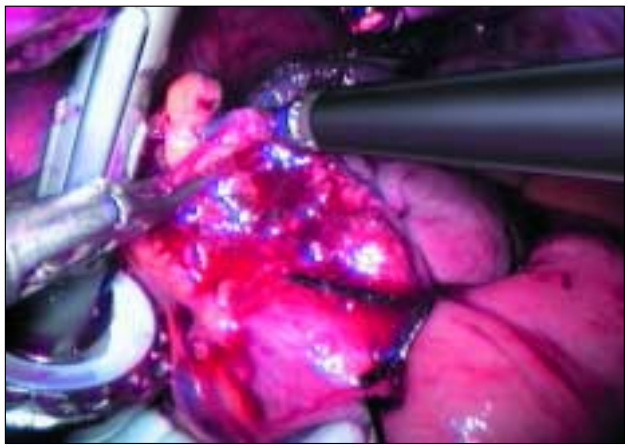


Fig. 21
The anvil is passed through the opening in the gastric pouch.

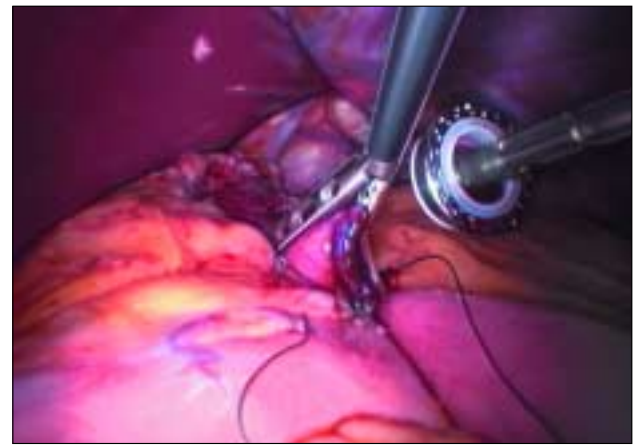


Fig. 22
The pouch is grasped and the stapler head advanced through the created opening; the jejunal limb is already fixed to the pouch.

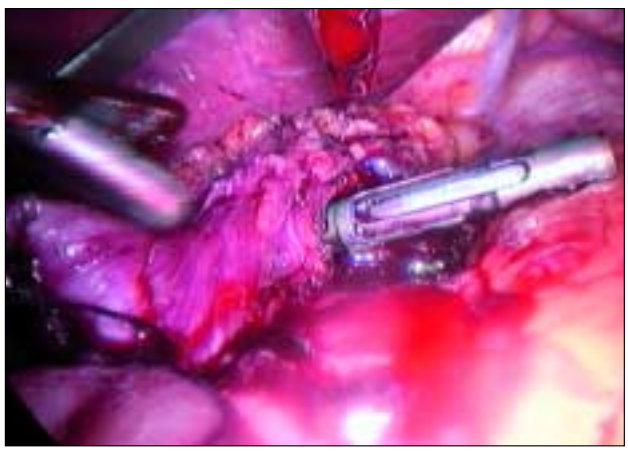


Fig. 23
The anvil is secured in the pouch by a purse-string suture.

In terms of safety, the authors believe the circular end-to-end anastomosis stapling technique is clearly preferable. However, the extremely thick abdominal walls pose technical difficulties in the correct guidance of the stapler. It is often tricky to pass the anvil through the small opening created in the gastric pouch (**Fig. 21**). The use of a specially designed "anvil grasper" (KARL STORZ, 33331 AV) simplifies this maneuver (**Fig. 22**). In any case, the anvil should be secured with a purse-string suture once the opening is made in the pouch (**Fig. 23**).

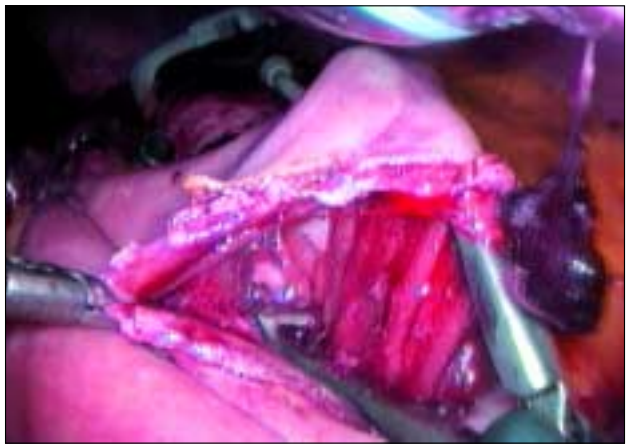


Fig. 24
Incision into the jejunal limb. The limb is then spread open to insert the stapler.

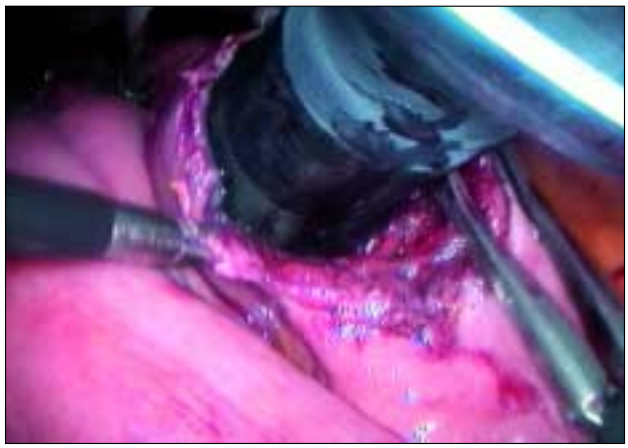


Fig. 25
Insertion of the circular stapler.

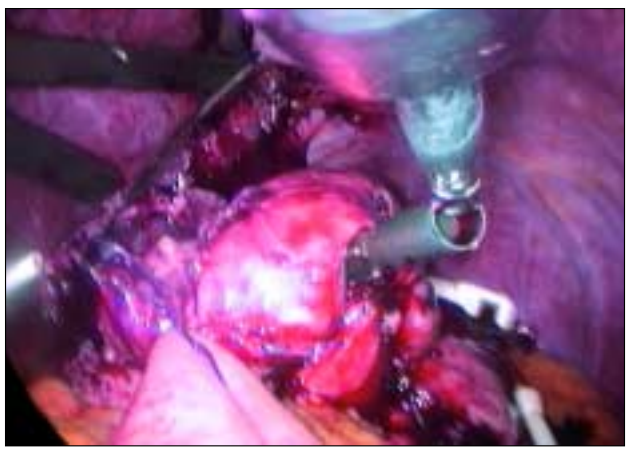


Fig. 26
Connection of the anvil to the stapler head.

The opening in the jejunal limb must be created far enough on the mesenteric side to facilitate insertion of the stapler (**Fig. 24**). The stapler is inserted while the limb is secured in position with a forceps (**Fig. 25**). A gentle twisting motion may facilitate passage of the stapler. Preliminary placement of fixation sutures can be helpful, ensuring that no undue tension is produced while connecting the anvil to the stapler head. (**Fig. 26**). After completion of the anastomosis, the stapler must be removed very carefully since tactile sensitivity may be attenuated at this point (**Fig. 27**). The major incisions for the circular stapler are at risk of getting infected. Therefore, the stapler should be removed through the abdominal wall only in a protected manner (**Fig. 28**). The authors saw one case of severe local infection in a total of 16 circular stapler anastomoses.

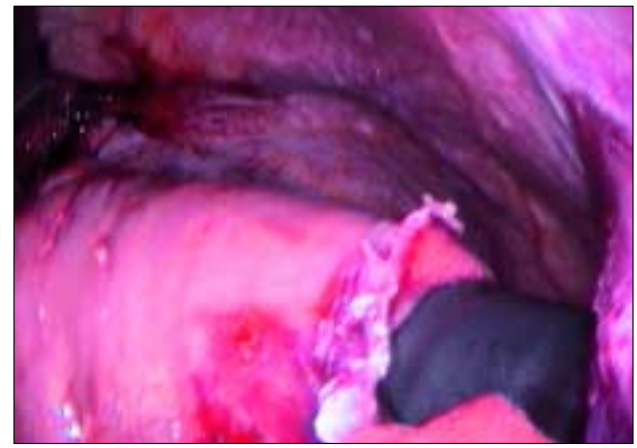


Fig. 27
Careful removal of the stapler after completion of the anastomosis.

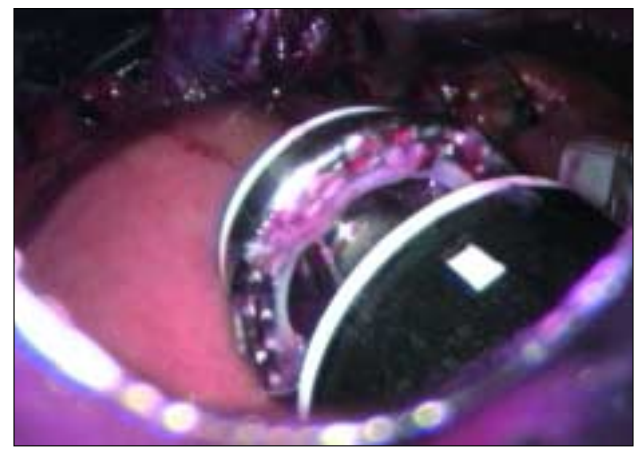


Fig. 28
After completion of the anastomosis, the circular stapler is a potential source of infection; it must not come into contact with the abdominal wall.

Commercially available trocars for circular staplers are too short for use in obese patients. Therefore, synthetic films may be used as an alternative option to maintaining the patency of the ports while also protecting the abdominal wall. 13-mm trocars are required if linear staplers are used. Wound infections are less likely under these circumstances since there is no need to punch any tissue and the stapler can be passed through the trocar without coming into contact with the abdominal wall.

The authors have not observed a single case of wound infection in 31 continuous anastomoses (posterior wall anastomosed by use of a stapler, anastomosis of the anterior wall by continuous laparoscopic "hand-sewn" suture, see **Figs. 29 a–c**). The diameter of the anastomosis should be at least 8 mm. In the course of 30 successive procedures the authors have inserted an 8-mm nasogastric-jejunal probe for determination of the anastomotic size only. After completion of the anastomotic suture and laparoscopically controlled removal of the probe, the authors dispensed with postoperative reinsertion.

To an increasing degree, surgeons dispense with internal drainage of the anastomosis. In this case, the anaesthetist verifies mobility of the tube. To achieve adequate decompression, it is advantageous to place the lateral openings of the nasogastric tube inside the jejunal limb and the pouch. The nasogastric tube is fixed to the patient's nose.

Since post-operative anastomotic insufficiencies are associated with high rates of morbidity and mortality, a leak test with methylene blue solution is performed during the operation. For this purpose, clips are applied to briefly exert pressure on the jejunum at the distal end of the nasogastric tube. At least 250 ml of methylene blue solution are injected under pressure through the NG tube. Any leakage detected requires immediate repair by manual seromuscular suture.

As an alternative leak test method, air may be insufflated while the area of anastomosis is immersed under water. In general, fixation sutures should be placed between the descending jejunal limb and the gastric pouch to ensure that traction on the anastomosis from the weight of the mesentery is reduced when the patient is mobilized early.

Fig.: 29a
Gastrojejunostomy, "hand-sewn" anastomosis.

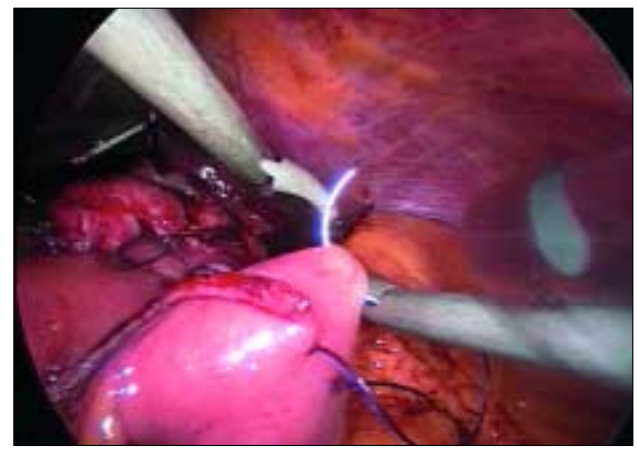


Fig.: 29b
Oversuturing of the staple lines at the end of the jejunal limbs is not mandatory, but can be a reliable method to stop hemorrhage from the staple line.

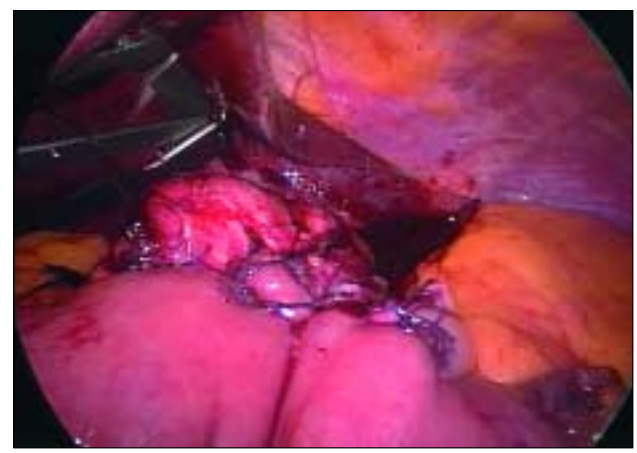


Fig. 29c
Gastrojejunostomy and oversewn end of the jejunal limbs after completion of the gastrojejunostomy.

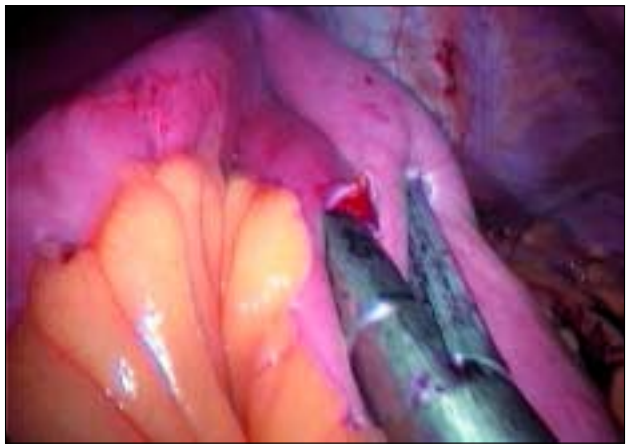


Fig. 30
Entero-enteral anastomosis (posterior wall by use of a stapler).

Fig. 31
Creation of a window in the antimesenteric aspect of the small intestine using an ultrasonic dissector.

Fig. 32
Insertion of the linear stapler into the two limbs of the small intestine that are to be anastomosed.

Superior mastery of suture skills and sturdy needle holders are fundamental to ensure that the suture is safely placed, even under extreme working angles. In the hands of the authors, the KOH Macro Needle Holder 26173 KC (KARL STORZ) produces outstandingly good results.

4.2 Entero-enteral Anastomosis

Next, the ligament of Treitz is identified followed by transection of a 50 cm length of the jejunal limb using a linear stapler (length 45 mm, 3.5 mm staples). To ensure that the anastomosis if free of tension, an incision of approx. 5 cm is made in the mesenterium. The jejuno-jejunal anastomosis is created approx. 70 – 150 cm from the site of gastrojejunostomy depending on the patient's BMI. A general rule of thumb may be that the higher the BMI, the longer the alimentary limb must be sized to fit.

If the length of the jejunal limb approximates 150 cm or even more, the function of the procedure turns into a biliopancreatic bypass. To minimize the incidence of bile reflux, which is rather unresponsive to conservative therapy, a minimal distance of 50 cm should be maintained. Some variations of the bypass operation use a larger distance, but are associated with a higher risk of malabsorption.

The entero-enteral anastomosis is created by applying the side-to-side technique using a 30-mm linear stapler (**Fig. 30**). For this purpose, an incision must be placed first in the antimesenteric aspect of the jejunum (**Fig. 31**). The linear stapler is then inserted into the jejunal limbs, once they are aligned parallel to each other (**Fig. 32**).

A continuous suture is applied to close the remaining enterotomy (**Fig. 33**). At this site, it is difficult to perform a leak test by use of methylene blue solution. As such, profound proficiency in laparoscopic technique is mandatory. It is important to check for any hemorrhage from the staple line prior to closure of the enterostomy (**Fig. 34**). Any hemorrhage must be stopped by placement of a suture. It is also important not to generate a dead end to avoid manifestation of symptoms of blind limb syndrome (**Fig. 36**). The completed anastomosis should be free of any signs of leakage when pressure is exerted on it (**Fig. 36**).

Two drains are placed, one near the gastro-jejunal anastomosis and the other near the jejuno-jejunal anastomosis.

Fig. 33
Continuous hand-sewn suture of the anterior wall.

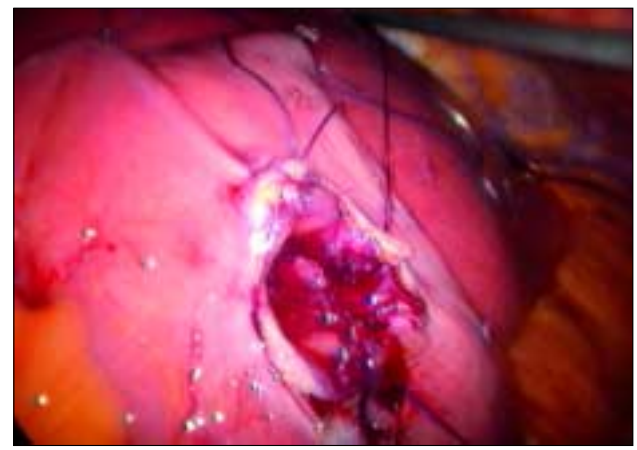


Fig. 34
The staple line must be thoroughly inspected for signs of hemorrhage. Any hemorrhage must be stopped by a purse-string ligature.

Fig. 36
Completed entero-enteral anastomosis (suture of the anterior wall by use of absorbable suture material).

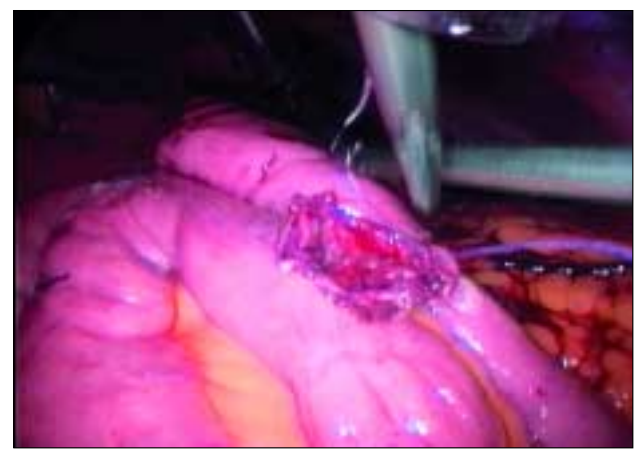


Fig. 35
The anastomosis should not create a dead end.

4.3 Postoperative Phase

Since tachycardia occasionally is the only sign of significant problems, postoperative monitoring in the ICU is of particular importance. The patient should be mobilized on the evening of the day of surgery. The high incidence of atelectasis and low oxygen saturation often makes breathing exercises (e.g., Triflow) necessary for tachycardia patients. All patients should be given thrombosis prophylaxis and low molecular weight heparin (at a dose adjusted to body weight).

The nasogastric tube is removed 24 hours after surgery and liquid alimentation can be given on day 2 after X-ray contrast imaging of the pouch and entero-enteral anastomosis. The drainage is removed 36 hours after the operation. Postoperative alimentation must be restricted to fluids (e.g., soups). On postoperative day 14, a bland diet can be initiated (white meat, cooked fish, easily digestible, low-fiber, and no raw vegetables or fruit).

Serious disturbance of the wound healing process is rare, but the occurrence of hematomas and seromas is quite common. For this reason, we normally continue draining the subcutis in most patients for 1–2 days to reduce the incidence of wound healing disturbances. In the event of subcutaneous fluid collection, we attempt drainage by slightly spreading the wound margins. Occasionally, stenosis of the gastrojejunostomy is encountered in the early postoperative phase. Balloon dilation of the stenosis under endoscopic control may be indicated in some patients.

5.0 Results

Bypass operation outcomes with respect to weight loss and improvement of quality of life are convincing, provided the operation is performed at centers with a sufficiently large patient population. *Wittgrove* performed 1,500 operations by 1991 and *Schauer* 500 operations by March 2002. The general rate of complications (thrombosis, embolism, postoperative hernia, etc.) of the laparoscopic procedure is clearly lower as compared to the patient population subjected to laparotomy. The laparoscopic approach requires the surgeon to have special expertise and practical skills, and the learning phase is quite long.

Weight loss outcomes for the Roux-en-Y bypass are impressive. Laparoscopic conversion surgery after gastric bypass is of rare occurrence.

The extremely long duration of the surgery with the patient in the reversed Trendelenburg position accounts for the relatively high rate of complications and lethality, aside from the challenging nature of the procedure. If the duration of surgery is allowed to extend for a very long period, deep vein thrombosis and other thromboembolic complications must be anticipated.

The rate of complications is in the range of 6.7–15% as far as the laparoscopic approach is concerned. The rate of 6.7% for minor and major complications as reported by *Schauer et al.* as well as the rate of 12.6% reported by *Wittgrove* (1999) seem too low. The mean follow-up in these cases was only 12.5 months, which may be too short an interval to allow for a conclusive statement. In contrast, the 15% rate of major complications reported by *Gagner et al.* appears more realistic.

5.1 Lethality

On the basis of 2,073 cases, a lethality rate of 0.2% has been calculated by *Gentileschi et al.* (2002). The extremely long duration of surgery with the patient in the reversed Trendelenburg position accounts for the relatively high rate of complications and lethality, aside from the challenging nature of the procedure. Deep vein thrombosis and other thromboembolic complications must therefore be anticipated, if the duration of surgery is allowed to extend for a prolonged period. A recent prospective randomized study comparing 21 laparoscopic and 21 open gastric bypass operations demonstrated that the laparoscopic technique can be performed with a high level of patient comfort (*Westling et al.,* 1999 A). However, the learning phase is extensive (see conversion) and the duration of surgery is subject to great variation (**Tab. 3**).

Data published by various authors on laparoscopic gastric bypass operations

Authors	Year	OP	BMI	OP Time (min.)	Lethality
Lönroth et al.	1996	8	38	250	0 %
Gustavsson & Westling	1998 A	32	n.m.	n.m.	0 %
Wittgrove & Clark	1998 A	300	n.m.	240[2]	0 %
Wittgrove & Clark	1999 A	500	n.m.	135	0 %
Gagner et al.	1999 A	52	55	241	0 %
Schauer et al.	1999 A	15	56	280	0,8 %
Schauer P	1999	1	53	408	0 %
Westling et al.	1999 A	51	55	n.m.	0 %
Schweitzer et al.[1]	1999	8	44	145 – 270	0 %
Lönroth et al.	2000 A	76	43[3]	n.m.	1,3 %
Schauer et al.	2000	275	n.m.	n.m.	0,4 %
Higa et al.	2001	1500	n.m.	up to 60	0 %
Nguyen et al.	2001	51	45	232 ± 43	0 %
Westling et al.	2001	30	42	n.m.	0 %
Korenkov et al.	2002 A	5	56,7	270 – 450	0 %
DeMaria et al.	2002	281	48,1	162 – 234	0 %
Papsavas et al.	2002 A	107	48,5	n.m.	0 %
Results of the authors	2002	67	56,5	80 – 195	0 %

1: Hand-assisted (pneumo-sleeve)
2: In the last 20 cases: 120 min
3: BMI 22 – 66 (the indication criteria applied were more than questionable!)
n.m. = no mention

Tab. 3:
Data of primary laparoscopic gastric bypass operations.

5.2 Morbidity

Based on a review of the published literature with an evidence level above II, *Gentischeli et al.* (2002) calculated a surgery-related disorder rate of 16% (332/2,073). A broad range of variation (6.7–75%) was observed in laparoscopic "hand-assisted" operations (*Schweitzer et al.*, 1999).

For comparison: The incidence of complications during the era of "open" surgery (involving abdominal incision) was as high as 16%. The study by *Lee et al.* reported the following **complication rates:**

- 13 % Revision surgeries
- 4,9 % Anastomotic insufficiency
- 2,4 % Intestinal obstructions (ileus)
- 1,2 % Splenectomy
- 1,2 % Pulmonary embolism
- 0,8 % Ulcers at the site of anastomosis
- 1,8 % Ulceration

Number of Operations:	**69**	**69**	**69**
Age (years)	39	39,7	39
Body weight (kg)	130	124.8	124.8
BMI (kg/m^2)	45.7	44.7	45.9
Duration of surgery (min.)	193	163 +	151++
Overall morbidity (%)	20.3	21.7	20.3
Major complications (%)	10.1	7.2	1.4+++

Tabelle 4:
Outcomes of laparoscopic bypass surgery and learning curve effect (*Suter et al.,* 2002).

In a series of patients treated at *Sahlgrenska University Clinic in Gothenburg, Sweden,* three "leaks" (anastomotic dehiscences) and six cases of hemorrhage were observed among the first 76 patients. There was one fatality due to hemorrhage obstructing the lumen of the gastroenteral anastomosis and leading to gastric dilation and ensuing perforation.

In addition, many patients suffer from postoperative retching and dumping syndrome unless they strictly follow the alimentary regimen.

The morbidity rate, and especially the incidence of major complications, depends on the experience of the surgeon. *Suter et al.* (2002) divided their patient population into three groups. The duration of surgery and the incidence of major complications showed a significant decrease with increasing number of operations performed, providing a clear correlation with the experience of the surgeon (**Tab. 4**).

5.3 Conversion Rate

Gentischeli et al. (2002) calculated a conversion rate of 2.4% for studies published by 2002 (50/2,073). The complexity of the procedure accounts for the fact that the initial conversion rate and a long learning phase can be anticipated. A conversion rate of 33% was reported by *Westling* (1999). *Lönroth et al.* (1996) reported a conversion rate of 25%, mainly due to technical difficulties and complications. Note, that these are initial results only. Once a surgeon has performed several hundred procedures, the conversion rate tends to approach zero.

5.4 Reasons for Conversion

The most common reasons for conversion are related to technical difficulties in completing the operation within a reasonable and justifiable period of time. *Baltasar et al.* (1998) converted because of hemorrhage, inability to insert the stapler into the esophagus, technical failure of the stapler and difficulties in creating the retrogastric tunnel.
Organ perforation was another common reason (*Lönroth et al.*, 1996). A short, fat-rich mesentery is another reason for conversion, provided it is found impossible to sufficiently mobilize the mesentery (*Lönroth et al.*, 1999).

5.5 Excess Weight Loss

Weight reduction outcomes are not generally different from open gastric bypass surgery, which are known to be excellent. Between 72% and 82% of the excess weight (*excess weight: actual weight minus ideal weight)* are lost in the first year after LRYGBP (**Diagram 1**).

Suter et al. (2002) evaluated their results on the basis of success parameters and found the results to be very good (**Diagram 2)**.

The BMI drops parallel to the loss in body weight (**Diagram 3**). This diagram shows the change in body mass index in patients with a BMI of less or more than 50 kg/m^2.

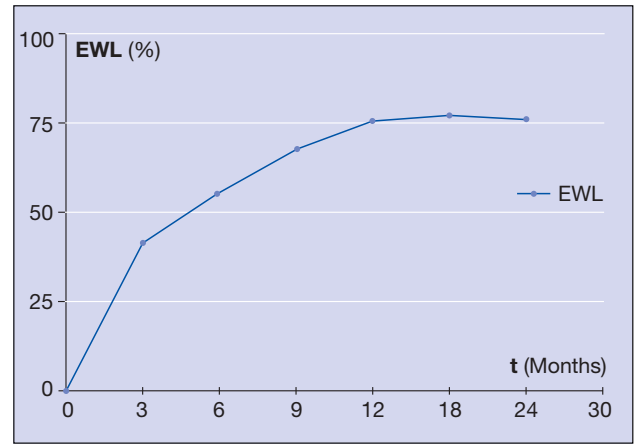


Diagram 1
Excess weight loss (EWL) after laparoscopic gastric bypass surgery. More than 90% of morbid obesity patients (BMI 40–50) report a definite success after 18 months.

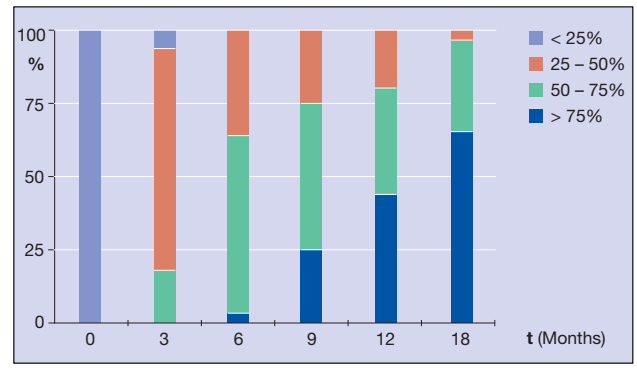


Diagram 2
Success rate after laparoscopic gastric bypass surgery according to the criteria specified by *Reinhold.*
(Excess weight loss <25 %, 25–30 %, 50–75 % and > 75 %).

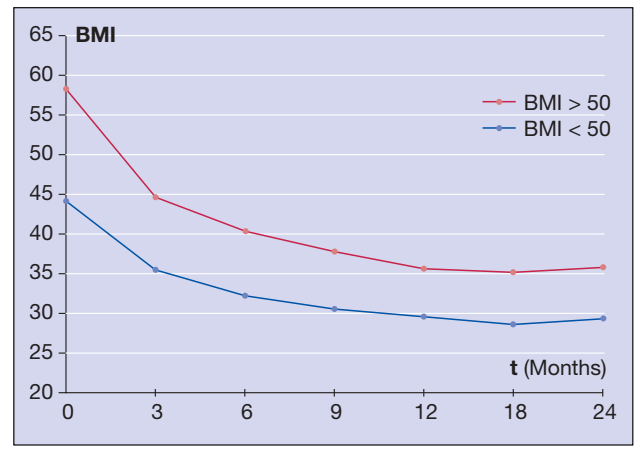


Diagram 3
Body mass index after laparoscopic gastric bypass surgery. Different curves are obtained for the populations of *super-obese* (BMI > 50) and *morbidly obese* (BMI 40 – 50) patients.

5.6 Improvement of Comorbidities

Sleep apnea syndrome often subsides after an excess weight loss of only approx. 20 kg. In the series described by *MacDonald* (2000), the incidence of hypertension was reduced from 59% before surgery to 21% after five years and 29% after 16 years. The incidence of diabetes mellitus dropped from 26% before surgery to 4% and 7% at 5 and 16 years post-surgery, respectively. Disturbances of the locomotor system decreased from 29% to 4% in only five years. Sixteen years after gastric bypass surgery this rate increased again (15%), which may be explained as a normal result of aging. The scores from psychological tests showed a continuous improvement during the first two years after surgery, but all parameters returned to the preoperative baseline levels by the fifth postoperative year. This observation is a reflection of the fact, that patients are slow in realizing that weight reduction does not solve all of their problems. Moreover, the initial success, consisting of rapid weight reduction, rapidly dims and the patients begin to understand that a strict diet and physical activity are essential for achieving optimal body weight.

Most impressive are the therapeutic effects of weight reduction by gastric bypass surgery on the incidence of diabetes mellitus. *MacDonald* (2000) reported a retrospective comparative analysis of morbidly obese diabetic patients with no weight-reducing surgical procedure versus a comparable group after gastric bypass surgery, and found the rate of fatalities in the control group to be 4.5-fold higher than in the group[3] subjected to bypass surgery. Whereas 28% of the obese patients with diabetes in the control group died within the first 6.2 years, only 9% of the successfully treated bypass surgery patients died within a period of 9 years. The stated rate of fatalities includes perioperative mortality. The effect was particularly pronounced for cardiovascular morbidity, which accounted for 54.5% of the fatalities in the control group, but only 14.3% among patients subjected to gastric bypass surgery. These data are the best results published to date and indicate that gastric bypass surgery possesses the potential to strongly reduce the mortality and morbidity of obese patients.

5.7 Quality of life

The results of surgery in regard to improving quality of life (QoL) measures of excess body weight are apparent in all QoL tests (**Diagram 4**). The results of the author's prospective randomized study clearly demonstrate the improvement in the patient's quality of life after bypass surgery (*Weiner R. et al.,* 2002).

Diagram 4 illustrates the sustained improvement in quality of life after bypass surgery. Since the SF-12 index contains no commanding parameters related to weight loss and comorbidities, it is not possible to describe the outcome of surgery by this means. Bariatric surgery-specific indices reflect the positive effects of successful gastric bypass surgery more clearly.

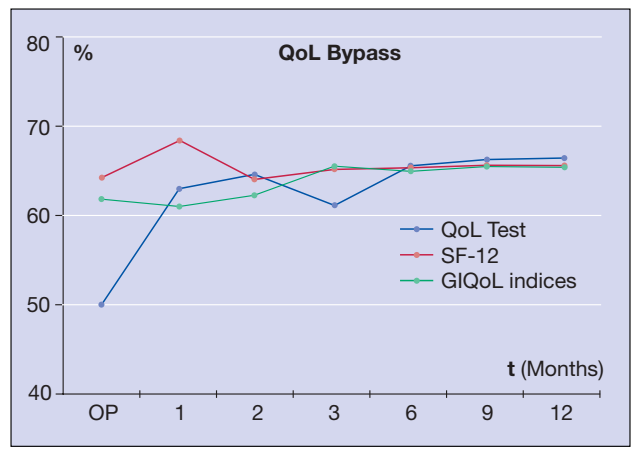


Schaubild 4
Indices of quality of life tests after laparoscopic gastric bypass surgery.
GIQoL = Global index of Quality of Life.

6.0 Complications

The technical aspects of the laparoscopic gastric bypass (**LGB, L**aparoscopic **G**astric **B**ypass) are a true challenge for any surgeon. Initial operating times of eight hours and more are not rare, especially as far as the retrocolic approach is concerned, and pose a problem mainly for the surgeon. The results of the operation with respect to weight loss and improvement in quality of life are convincing as long as the operation is performed at centers with a sufficiently large population of patients. *Wittgrove* performed 1,500 operations by 2000 and *Schauer* (2002) 500 operations by March, 2002. The number of procedures continues to rise dramatically across the United States. The weight reduction results after 100 LGB procedures are convincing, though the complication rate is high and the learning phase long (*Chevallier et al.,* 1999).

6.1 Hemorrhage

This very complex operation is associated with a high risk of hemorrhage at various stages of the procedure, from the creation of a slit in the mesocolon to retrogastric dissection and creation of the anastomosis. According to the literature, hemorrhage-related complication rates range between 0% and 13%. Hemorrhage from the staple line is a particularly common occurrence and requires suturing. However, only rarely does hemorrhage constitute a reason to convert to open surgery.

Refined dissection skills under the special conditions of obesity are a major prerequisite for prevention of undue hemorrhage. This particularly applies when using an ultrasonic dissector to create an opening in the fat-rich mesocolon.

Bleeding from the staple line cannot always be prevented, however, it can easily be controlled and should not be reason for conversion.
Hemorrhage from the mesocolon can be managed with an ultrasonic dissector. Hemorrhage from the staple line can be stopped by compression using an atraumatic forceps, suturing or clip application. Peristrips can also be used, but they are an extremely costly alternative, since they are made of bovine pericardium.

6.2 Anastomotic Insufficiencies

The creation of the gastrojejunal anastomosis is a very complex and difficult step of the operation. There is no reason to suspect that the causes of postoperative anastomotic insufficiency might be correlated with causal mechanisms different from those in open gastrojejunostomy. In many cases, these causes remain unclear. Disturbed circulation (compression by use of a stapler, skeletonization of the small intestinal limb) seems to play a central role in this context.

Although there are a large variety of anastomotic insufficiencies (0–25%), the experience of the surgeon may be of particular significance. *Gagner* et al. (1999) reported a rate of 5.7% after a total of 52 procedures. While two cases of leakage after “hand-sewn” anastomoses were observed within the first eight procedures, only one more case of a stapler anastomosis was reported in the following 44 procedures.

Working with the largest patient population, *Wittgrove* and *Clark* reported only nine cases of anastomotic leakage (3%) of which two had to be re-operated by open surgery, whereas the remaining seven cases were re-operated using the laparoscopic technique. In 1999, the same authors reported only two cases of leakage after 200 procedures (1%), such that the total incidence of leakage was only 2.3% (500 procedures).

Lönroth (2000) made records of early leakage in 4% of the cases, with two of these concerning gastroenteral anastomoses and one associated with enteroanastomosis.

Careful creation of the anastomosis and testing for leakage and adequate blood circulation are the main prophylactic measures for the prevention of anastomotic insufficiencies.

Stapler anastomoses that occur in the course of a laparoscopic procedure may be advantageous in this respect as compared to “hand-sewn” anastomoses. Insufficiency of the gastrointestinal anastomosis is a life-threatening event in all patient populations. However, this complication poses a particularly high risk to morbidly obese patients and is associated with a high rate of fatality.

Caution:
Any sign of tachycardia (heart rate > 120 bpm) is sufficient reason to consider re-laparoscopy.

Ali et al. (2002) managed leakage secondary to LRYGB as follows:

- By **re-laparoscopy** 7 (50 %)
- **Successful closure** 1 (7 %)
- **Persistent leakage** 3 (21 %)
- **Conversion** 3 (21 %)
- By **laparotomy** as the initial treatment 3 (21 %)

6.3 Wound infection

The extremely thick abdominal walls in obese patients represent a potential infection risk, particularly in operations that require incisions to be made in the gastrointestinal tract.

Intestinal pathogens find ideal growth conditions and thrive in the poorly vascularized fatty tissue. Pathogenic contamination occurs at the trocar ports, especially where miniature laparotomy ("hand-assisted" operations) are performed.

Wound infection rates of up to 25% have been reported (*Schweitzer et al.*, 1999). *Gagner* reported three infection-related complications in a total of 52 procedures (5.8%), though one of these cases was an infected intraabdominal hematoma. This patient had to undergo revision surgery. The other two cases were "classical" wound infections. *Schweitzer et al.* (1999) treated two of eight patients (25%) for wound infections. Working with the largest patient population (300 patients), *Wittgrove* and *Clark* reported only 15 minor (5%) and two major (0.7%) infections.

The foremost concern in all procedures involving exposure of hollow organs is the prevention of infections at the site of the trocar port. Consequently, perioperative antibiotic prophylaxis is mandatory under these circumstances.

The antibiotic dose must be adjusted to body weight and administered every 2–3 hours during long operations to keep the concentration of active agents at an adequately high level. It remains unclear whether postoperative administration of antiseptic agents to the trocar incisions is capable of preventing infection.

Generously-sized incisions must be made and broad-range antibiotics administered under these circumstances.

Because of the range of germs involved in necrotizing fasciitis, radical surgical debridement is required to prevent the pathogens from spreading.

6.4 Postoperative Hemorrhage

Bleeding usually occurs at the site of the anastomosis, especially from the staple line, but there are a wide variety of other areas that represent potential sources of postoperative hemorrhage. This especially applies to the slit made in the mesocolon, since the extreme accumulation of fat in this area can make the timely identification of vascular structures quite difficult.

In the largest of patient populations *Wittgrove* and *Clark* (1998) found only a 1.3% rate of relevant postoperative hemorrhage requiring revision. Only one revision called for laparotomy, while three others were managed by a laparoscopic approach.

Lönroth (2000) reported a 7.9% rate of postoperative hemorrhage requiring transfusion.

Postoperative hemorrhage can be prevented only by a sophisticated surgical technique. It is mandatory that the operating field be closely inspected for any hemorrhage at the end of surgery. The indication for revision laparoscopy or revision laparotomy is based on the general guidelines of surgery. The decision should be taken without delay to spare the patient secondary complications, eliminate the need for transfusions and help prevent life-threatening situations.

6.5 Anastomotic Stenosis (Gastrojejunostomy)

Creation of the anastomosis under laparoscopic vision may pose technical difficulties, and the sutures placed under such conditions may leave behind an anastomosis that is too narrow.

Delayed stenosis is most often caused by local infection along the circular staple line. A digital patency test is not performed in laparoscopic operations that do not involve miniature laparotomy. Anastomotic stenosis rates ranging between 1% and 38% have been reported (*Wittgrove* and *Clark,* 1998; *Schweitzer et al.*, 1999).

A lower rate was reported by *Wittgrove* and *Clark* (1998), who observed only three cases of stenosis following 300 procedures. Upon the publication of their findings at the ASBS Meeting in San Diego, California, the authors reported eight cases of stenosis following 500 procedures (1.6%). Whereas two of the anastomotic stenoses among the patient population of

Schweitzer et al. (1999) could be treated by endoscopic dilation (at least temporarily), one patient (12.5%) had to undergo revision surgery.
For the most part, other authors did not report a complete follow-up in their publications.
The principles guiding the correct placement of the anastomosis are not different from those applied in conventional and laparoscopic technique.
Creation of the anastomosis by laparoscopic suture technique often poses technical difficulties because of limiting factors, such as confined anatomical space, traction on the anastomosis, impaired vision and others. The creation of an anastomosis by use of linear staplers is different from the commonly applied technique and it is often difficult to check adequately for possible sites of leakage.
Circular staplers provide for the best conditions to accomplish a clearly defined anastomosis.
Clinically relevant anastomotic stenosis can be treated by endoscopic-assisted dilation. However, insufficient dilation and recurrence are an indication for corrective revision surgery. Attempts at dilation are often futile and usually associated with increased patient risk. Only in the esophago-gastric junction is there is a reasonable prospect of success when choosing this therapeutic approach.

6.6 Anastomotic Stenosis (Entero-enteral Anastomosis)

Creation of the anastomosis under laparoscopic vision may pose technical difficulties, and the sutures placed under such conditions may leave behind an anastomosis that is too narrow.
Delayed stenosis is usually caused by local infection along the staple line. Since laparoscopic procedures do not involve miniature laparotomy, a patency test by digital palpation is not performed.
Tamoff et al. (2002) report anastomotic stenosis at a rate of 0.4% (4/939). The majority of surgeons have had to contend with this complication and report on it in their personal communications.
The guiding principles for correct placement of the anastomosis are not different from those applied in conventional and laparoscopic technique.
Similar to gastrojejunostomy, creation of the anastomosis by laparoscopic suture technique often poses technical difficulties because of limiting factors, such as confined anatomical space, traction on the anastomosis, impaired vision and others.
Clinically relevant anastomotic stenosis must be treated by revision surgery. Creation of an additional bypass may facilitate resolution of the problem by laparoscopic means.

6.7 Deep Vein Thrombosis

The rate of thromboembolic complications after surgery has dropped since perioperative thromboembolism prophylaxis in most institutions has become an integral part of the standard protocol. This is of special importance for laparoscopic surgery because of attendant circumstances that contribute to pathophysiological processes favoring deep vein thromboses in the legs and pelvis. These factors include reduced venous reflux owing to compression of the caval vein, long duration of surgery, and, especially, extreme patient positioning. The effects of two of these factors – extreme positioning and long duration of surgery – accumulate in laparoscopic gastric bypass operations (mean duration of anesthesia 314 min ± 90 min). In patients with a history of previous vascular disease, this may lead to thrombosis (*Elsmore* and *Losemore,* 1998) with occlusion of the major vessels (e.g., aortal thrombosis).

The incidence of thromboembolism (5%; 1/21 in *Westling* 1999; 2/52 in *Gagner et al.,* 1999) is clearly higher than in other laparoscopic standard operations. The clearly higher rate of thromboembolic complications in LGB procedures, which is due to a combination of prolonged operating times and the extreme position patients are placed in, requires prophylactic measures be taken. Laparoscopic gastric bypass surgery is associated with the highest incidence of thrombosis. However, laparoscopy is not the only contributing factor.
Scott et al. (1992) report on less than 0.01% thromboembolic complications after 12,000 laparoscopic procedures. Despite a number of individual case reports, it is not yet conclusive whether these observations can be attributed to an increased rate of complications following laparoscopic surgery.
Low dose heparinization has been the standard from the very beginning. Before the era of heparin prophylaxis, the rate of deep vein thrombosis of the leg following conventional cholecystectomy was 5%, a considerable rate (*Berquist et al.,* 1990). Limitation of the duration of gastric bypass operations is the critical factor in

the prevention of postoperative thromboembolic complications.
Early mobilization is another important prophylactic measure which has a very positive impact in the prevention of deep vein thrombosis of the leg. It may even compensate potential deficiencies.
Intraabdominal pressure is an essential factor in determining the degree of venous reflux. Pressure values above 15 mmHg must be strictly avoided, since they may cause stasis in the area of the venous reflux. Venous stasis can promote the development of thrombosis and thromboembolism and is a particularly important pathogenic mechanism in patients with a history of previous vascular disease. Low dose heparinization is part of the standard protocol for all surgical procedures and reduces the risk of thromboembolic complications. High-risk patients must be identified preoperatively and must receive physical treatment, such as intermittent pneumatic compression of the lower extremities. In severe high-risk cases, physical measures must be complemented by heparinization.
The therapeutic management of thromboses and thromboembolic complications follows generally accepted guidelines and does not differ from those commonly applied in minimally invasive surgical procedures. Heparinization in minimally invasive surgical procedures does not expose patients to the same high degree of risk found with major laparotomies or thoracotomies.

6.8 Anastomotic Ulcer

Only recently explored, the pathogenesis of ulcers has nullified many surgical therapeutic concepts. An improved understanding of the bacterial colonization of the stomach and duodenum and its impact on ulcer pathogenesis has led to a major revision of the indications for surgical management of this complication. The role of gastric acid should be insignificant since the acid-producing portions were eliminated. Anastomotic ulcers have been reported at a rate of 0–10 % (*Westling,* 1999).

In a comparison of 21 laparoscopic and 21 open operations, *Westling* (1999) observed two and one ulcers, respectively. The manifestation of ulcers is a procedure-specific problem unrelated to the surgical approach taken. Recent scientific findings corroborating the pathogenic role of Heliobacter in the infection process clearly demonstrate the need for a thorough bacteriological evaluation. The significance of the gastrin assay in recurrent ulcers is known and is similar to open surgery. Preoperative records of the patient's ulcer case history must be collected in detail (Heliobacter pylori, gastrin) to prevent formation of postoperative anastomotic ulcers. Hemorrhage is one of the strongholds of endoscopy. One of the therapeutic options includes assaying for the presence of Heliobacter pylori and subsequent eradication of this strain. However, these approaches are not always successful. In the presence of a recurrent ulcer following previous, non-surgical therapeutic attempts, secondary resection may become necessary. Since acid production is not a causative factor, it remains unclear whether recurrent ulceration following surgical treatment constitutes an indication for thoracoscopic vagotomy. The procedure is effortless to perform, but associated with serious pathophysiological side effects (diarrhea to name but one).

6.9 Small Intestinal Ileus

The eliminated Roux-en-Y limb may give rise to a number of potential complications. Most commonly, kinks and stenosis at the mesocolic opening lead to postoperative complications. Another common factor is the so-called Petersen hernia defect (**Fig. 36**) between the jejunal mesentery and the mesocolon (*Schauer et al.,* 1999).

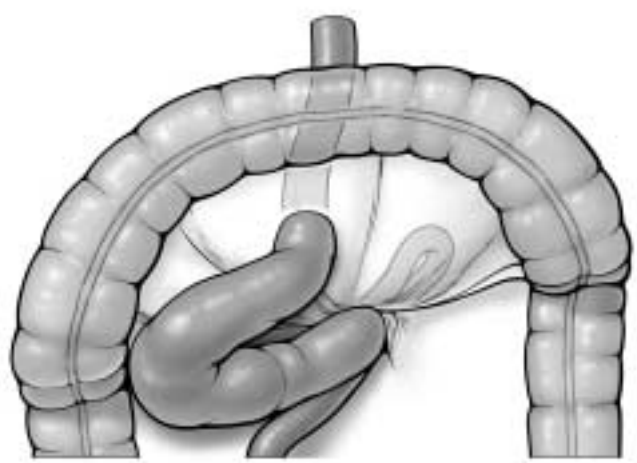


Fig. 36
Herniation of a jejunal limb at the mesocolic opening created during retrocolic bypass surgery.

Ileus rates of up to 38% after gastric bypass surgery have been reported in the literature; eight of 21 patients, treated by surgery, were afflicted with this complication (*Westling,* 1999).
Schauer (1999) reported two cases of ileus after 52 procedures and *Wittgrove* and *Clark* (1998) observed only three cases after 300 procedures. The latter authors included only those cases of ileus that required revision surgery after more than one month. Therefore, the incidence can be expected to be higher than stated.
Lönroth et al. (2000 A) performed three revision surgeries (after 10 days, five weeks, one year) due to ileus after treating a group of 76 patients. In one case, the patient required treatment by laparotomy for ileus caused by obstruction and torsion of a small bowel limb near the enteroanastomosis some five years following surgery.
Accurate fixation of the small bowel limb in a mesocolic opening fashioned with an optimum anatomic fit is the best prophylaxis against this serious complication. Clinical manifestation of mechanical ileus following gastric bypass surgery requires open revision surgery. Clinically, the complication may become apparent as unspecific abdominal spasm and retching, however one might tend to associate this with "overeating syndrome" when working with obese patients.
Schweitzer et al. (1999) successfully avoided intestinal infarction in two cases by performing early revision surgery. Conservative approaches are unlikely to be successful, whereas a rapid decision in favor of revision surgery can prevent intestinal infarct.

6.10 Fistulas and Abscesses

Suture dehiscences, especially after the use of staplers, may lead to the formation of fistulas. Abscesses are often found in association with anastomotic insufficiencies and are a late sequela. Infected hematomas are another frequent cause of postoperative abscesses. Since only isolated case reports are available, it may be conjectured that the incidence of abscess formation following gastric bypass surgery is lower than 1% (*Schauer,* 1999). However, the incidence may well be higher. Similar to open surgery, oversewing of the anastomosis is just an attempt at securing the anastomosis. The best prophylaxis against formation of abscesses is to create an optimum anastomosis with the stapler, while at the same time maintaining a sufficient level of blood circulation.
The decision on how to manage the patient – either by means of conservative or surgical treatment – depends on the manifest clinical symptoms.
Fistulas without septic complications can be managed with fibrin adhesive under endoscopic control.

6.11 Postoperative Incisional Hernia

The abdominal walls of extremely obese patients do not always allow individual layers of the abdominal wall to be exposed without extended incisions. There is an elevated rate of wound infections in the poorly vascularized fatty tissue, which constitutes another risk factor for postoperative herniation. According to *Suter et al.* (1999), the incidence of postoperative incisional hernias ranges between 0% and 13% in laparoscopic-assisted procedures (miniature laparotomies). Most publications make no mention of hernias, which does not mean they did not occur. The rate of hernias of 13% related to hand-assisted procedures may be compared with the results obtained in primary "open" gastric bypass surgery.

Gagner et al. (1999) observed only two postoperative hernias in their follow-up of 52 patients (3.9%).

Accurate closure of the abdominal wall in obese patients is a difficult task and requires the surgeon to exercise a great deal of diligence. In particular, the abdominal walls of obese women are rich in fat, making it quite difficult to accomplish wound closure at the site of the trocar port with the commonly practiced method. The instrument for fascial closure used by *Berci* is very useful in this step of the procedure. Wound infections must be prevented, since they may induce formation of postoperative incisional hernias.

Clinical symptoms are critical in the decision when to initiate postoperative hernia repair. The longer ago gastric bypass surgery was performed, the greater the degree of shrinking in subcutaneous fatty tissue, simplifying surgical management.

If the intestine is at imminent risk of getting entrapped in the hernia, the surgical procedure must be initiated at the earliest point in time to obviate the development of a potentially life-threatening situation.

After wound infection, one should wait as long as possible to prevent secondary wound-related infection.

6.12 Wernicke's Syndrome after Gastric Bypass

Chronic vomiting and large-scale cessation of the stomach's function lead to vitamin B deficiency, which may in turn lead to the development of neurological disorders. *Guspi et al.* (2000) described the case of a 23-year-old female patient who had a gastric bypass placed due to non-compliance following the removal of an adjustable silicone gastric band. Due to recurrent retching and termination of the gastric passage, the patient manifested vitamin B deficiency with ensuing neurological symptoms. These were reversible within 24 hours after parenteral administration of vitamin B.

Recurrent retching constitutes an indication for immediate action. Patients must be informed in detail about the symptoms and advised to present at the clinic without delay if they experience persistent retching.

Ensure that all patients receive sufficient parenteral vitamin supplements.
Elimination of the cause of persistent retching involves substitution of fluids, electrolytes, vitamins and trace elements to be initiated without delay.

Caution: If neurological symptoms manifest after bariatric procedures with concomitant persistent retching, vitamin B deficiency must be taken into consideration. The diagnosis may be made ex juvantibus, i.e., based on the result of therapy.

In the reported case of a Wernicke's syndrome with ophthalmopathological symptoms, parenteral vitamin B supplements must be administered in the ICU. It is particularly important to administer vitamin B1 and B6 at sufficient doses.

Emergency therapy: 100 mg thiamine per day (combination preparation containing vitamin B1 100 mg, vitamin B6 100 mg, and vitamin B12 1000 mg) **for 1 – 2 weeks. Depending on the preparation used, the parenteral administration may be given I.V. or I.M.**

6.13 Internal Hernia and Gastric Perforation

Serra et al. (1999) reported herniation of the small intestine through the opening created in the mesocolon and via a retrogastric pathway followed by gastric perforation due to internal herniation in the area of the jejuno-jejunostomy. Early CT imaging and laparotomy are adequate prophylactic measures for preventing the development of a life-threatening situation.

Literature

Please note: Extracts published on meetings are indicated with an "**A**" in the bib. reference (e.g. 1999 A).

1 BERGQVIST, D; MATZSCH, T; JENDTEG, S; LINDGREN, B; PERSSON, U (1990). The cost-effectiveness of prevention of post-operative thromboembolism.
Acta Chir Scand Suppl 556: 36 – 41

2 ELSMORE, SM; LOOSEMORE, TM (1998). Aortic thrombosis following laparosopic cholecystectomy.
Min Invas Ther Allied Technol 7: 475 – 476

3 GENTILESCHI, P; KINI, S; CATARCI, M; GAGNER, M (2002). Evidence-based medicine: open and laparoscopic bariatric surgery.
Surg Endosc 2002 May;16 (5): 736 – 44

3 GAGNER, M (1999). Gastric Bypass.
SAGES-Meeting 1999, San Antonio, Texas, USA, 24 – 27 March 1999, Surg Endosc. 13: 1 – 94

4 GUSPI, SF; HERNANDEZ, M; GARCIA-LODA, P; JARDI, JM; OLIVE, JM; SALAS, J; del CASTILLO, D (2000). Encepalopathologia de Wernicke como complication de chirurgia bariatrica. Casa clinico.
III Reunion national de la sociedad espanola de cirurgia de la obesidad
Santander, Spanien, 1–3 March 2000

5 GUSTAVSSON, S; WESTLING, A (1998 A). Laparoscopic Roux-en-Y Gastric Bypass.
Abstract of the Third World Congress of the IFSO, Brügge (Belgien), 3 – 5 September 1998
Obes Surg 8: 331 – 414

6 JONDES, KB (1998 A). Twelve years and 1563 Roux-en-Y gastric bypass procedures: is the laparoscopic adjustable gastric and truly the method of choice in obesity ?
Abstract of the 3rd World Congress of the IFSO, Brügge (Belgien), 3 – 5 September 1998
Obes Surg 8: 331 – 414

7 LÖNROTH, H; DALENBÄCK, J; HAGLIND, E; LUNDELL, L (1996). Laparoscopic gastric bypass: another option in bariatric surgery
Surg Endosc 10: 636 – 638

8 LÖNROTH, H (1998) Laparoscopic gastric bypass.
Obes. Surg 8: 563 – 565

9 MacDONALD, K G (2000). Gastric bypass in morbid obesity. Chirurg Feb; 71(2):140 – 145

10 SCHAUER, P (1999 A) Gastric Bypass.
SAGES-Meeting 1999, San Antonio, Texas, USA, März 24. –27. Surg Endosc. 13: 1 – 94

11 SCHAUER, PR; IKRAMUDDIN, S; GOURASH, W; PANZAK, G (1999). Laparoscopic Roux-en-Y gastric bypass for super-morbid obesity.
SAGES-Meeting 1999, San Antonio, Texas, USA, März 24. – 27. Surg Endosc. 13: 1 – 94

12 SCHAUER, PR; IKRAMUDDIN, S (2001). Laparoscopic surgery for morbid obesity.
Surg Clin North Am 81: 1145–1179

13 SCHWEITZER, MA; BRODERICK, TJ; DEMARIA, EJ; SUGERMAN, HJ (1999). Laparoscopic-assisted Roux-en-Y gastric bypass.
J Laparoendosc Adv Surg Tech A 9:449 – 453

14 WEINER, R (Hrsg.) (2002). Komplikationen in der minimal-invasiven Chirurgie. Unter Mitarbeit von Hasso Berker, Reinhard Bittner, Rafael Blanco Engert, Peter Heinz, Johannes Heimbucher, Ulrich Hildebrandt, Andreas Kirschbaum, Bernhard Leibl. Angela Ohlinger, Peter Prohm, Raul Rosenthal, Felix Schier, Axel Skuballa, Sylvia Weiner und Günter Winde. Kaden-Verlag, Heidelberg

15 WESTLING, A; GUSTAVSSON, S (2001). Laparoscopic versus open Roux-en-Y gastric bypass: a prospective randomized trial.
Obes. Surg 11: 284 – 292

16 WITTGROVE, AC; CLARK, WG (1998 A). Laparoscopic gastric bypass, Roux en-Y: techniques and results in 300 cases with 3-48 month follow-up.
6th World Congress of Endoscopic Surgery.
Rom, Italien, 3. – 6. 6. 1998, Monduzzi Editore S.p.A., Bologna, Italien, 165 – 173

17 WITTGROVE, AC; CLARK, WG (1999 A). Laparoscopic gastric bypass, Roux en-Y: techniques and results in 500 cases.
16th Annual Meeting of the American Society for Bariatric Surgery, San Diego, 9. – 12. 6. 1999

18 WITTGROVE, AC; CLARK, GW (2001). Combined laparoscopic/endoscopic anvil placement for the performance of the gastroenterostomy.
Obes Surg 11: 565 – 569

Recommended Set for Laparoscopic Roux-Y-Gastric-Bypass

Recommended Instrument Set, Units and Accessories

26003 BA 1 HOPKINS II® **Forward-Oblique Telescope** 30°,enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red

or:

26003 FA 1 HOPKINS II® **Telescope** 45°, enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: black.

495 NCS 1 **Fiber Optic Light Cable,** diameter 4.8 mm, length 250 cm.

30103 MTR 1 TERNAMIAN **EndoTIP™ Cannula,** size 11 mm, color code: green, **consisting of:**
30103 T4 **Cannula** with thread and rotatable insufflation stopcock, length **10.5 cm.**
30103 M1 **Multifunctional Valve,** size 11 mm.

30108 MTR 6 TERNAMIAN **EndoTIP™ Cannula** size 13.5 mm, color code: blue, **consisting of:**
30108 T4 **Cannula** with thread and rotatable insufflation stopcock, length **11.5 cm.**
30108 M1 **Multifunctional Valve,** size **13,5 mm.**

30140 HB 1 **Reducer,** 13 mm/5 mm.
30142 HB 6 **Double Reducer,** 13 mm/10 mm and 13 mm/5 mm.

30623 URL 1 **Liver Retractor,** size 10 mm, large contact surface, length 36 cm.

28172 S 1 **Adjustable Holder,** for fixation of telescopes and sheaths ranging in size from 4.8 mm up to 12.5 mm, **consisting of:**
28172 HS **Articulated Arm,** only.
28172 HR **Rotatable Lever** for fixation to operating table.
28172 US **Holder** for telescopes and sheaths ranging in size from 4.8 mm up to 12.5 mm.

26173 KC 2 KOH **Macro Needle Holder,** ergonomic handle with ratchet, jaws curved right, size 5 mm, length 33 cm, for use with suture material size 0/0 to 7/0.

33533 BLS 2 CLICK*line* BABCOCK **Clamp, rotating, dismantling,** rounded, long jaws, metal handle with hemostat style ratchet, size 5 mm, length F cm.

33500 CM 1 CLICK*line* **Metal Outer Tube** with cm-marking, size 10 mm, length 36 cm, for use with forceceps insert 33510 BLS.

33333 ON 2 CLICK*line* **Grasping Forceps, rotating, dismantling,** with especially fine serration, fenestrated, metal handle with hemostat style ratchet, size 5 mm, length 36 cm.

33325 ML 1 CLICK*line* KELLY **Dissecting and Grasping Forceps, rotating, dismantling,** with connector pin for unipolar coagulation, size 5 mm, length 36 cm, double action long jaws.

33331 AV 1 CLICK*line* **Anvil Grasper, rotating, dismantling,** size 5 mm,length 36 cm, double action jaws.

33325 KW 1 CLICK*line* MATKOWITZ **Grasping Forceps, rotating, dismantling,** with connector pin for unipolar coagulation, size 5 mm, length 36 cm, double action jaws.

33300 CM 1 CLICK*line* **Outer Tube** with cm-marking, insulated, size 5 mm, length 36 cm, for use with forceps insert 33310 KW.

34321 MA 1 CLICK*line* METZENBAUM, **Scissors, rotating, dismantling,** with connector pin for unipolar coagulation, size 5 mm, length 36 cm, curved, serrated spoon blades, length of blades 17 mm.

30775 UF 1 **Coagulation and Dissecting Electrode,** L-shaped, insulated, with connector pin for unipolar coagulation, size 5 mm, length 36 cm.

30775 UFE 1 **Exchangeable Electrode Tips,** L-shaped, package of 6 pieces.

30444 LR 1 **Clip Applicator, rotating, dismantling,** for ligating clips 26060 AL (medium-large), with ratchet to lock the jaw part holding the clip, **consisting of:**
30444 H **Metal Handle,** with ratchet.
30444 A **Metal Outer Tube.**
30440 LR **Insert** for ligating clips 26060 AL.

26060 AL 1 PILLING **Titanium Clips,** medium-large, sterile box with 16 cartridges, 10 clips each, for use with clip ≠ 30444 LR.

37113 L 1 **Pistol Grip Handle,** for suction and irrigation, for use with suction-coagulation cannulas size 5 mm and irrigation and suction tubes, size 5 mm and 10 mm, with central instrument channel, autoclavable, **consisting of:**
37113 PL **Pistol Grip Handle,** max. pressure 400 mmHg.
20 3000 47 **Silicone Tubing Set.**

37360 LH 1 **Irrigation and Suction Tube,** with lateral holes, size 5 mm, length 36 cm.

37560 LH 1 **Irrigation and Suction Tube,** with lateral holes, size 10 mm, length 36 cm.

26173 AM 1 BERCI **Fascial Closure Instrument** for subcutaneous ligature of trocar incisions, size 2.8 mm, length 17 cm.

Optional overlength instruments and telescopes:

26003 BEA 1 HOPKINS II® **Forward-Oblique Telescope** 30°, enlarged view, diam. 10 mm, length 42 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red.

31103 MTR 1 TERNAMIAN **EndoTIP™ Cannula,** size 11 mm, color code: green-red, **consisting of:**
31103 T4 **Cannula** with thread and rotatable insufflation stopcock, length 15 cm
30103 M1 **Multifunctional Valve,** size 11 mm.

31108 MTR 6 TERNAMIAN **EndoTIP™ Cannula,** size 13.5 mm, color code: blue-red, **consisting of:**
31108 T4 **Cannula** with thread and rotatable insufflation stopcock, length 15 cm
30108 M1 **Multifunctional Valve,** size **13.5 mm.**

Please note: Forceps, Scissors and Needle Holders are also available in a length of 43 cm.

Videoendoscopic Imaging Systems and Accessories:

22 2200 30-3 1 **IMAGE 1™ S3, Three-Chip Camera Head,** color system **PAL.**

22 2201 30-3 1 **Same,** color system **NTSC.**

22 2000 11-1 1 **IMAGE 1™ Camera Control Unit Basic,** with **integrated KARL STORZ Communication Bus System (SCB)** and **digital image processing module,** including mains cord, keyboard, 2 connecting cables for video printer / video recorder, 3 BNC connecting cables, length 180 cm; S-VHS (Y/C) connecting cable, length 180 cm, special RGB-connecting cable, length 180 cm; SCB connecting cable, length 100 cm.

20 0901 01 1 **KARL STORZ 15" Touch Screen Monitor,** stand-mounted, color systems **PAL, NTSC.**

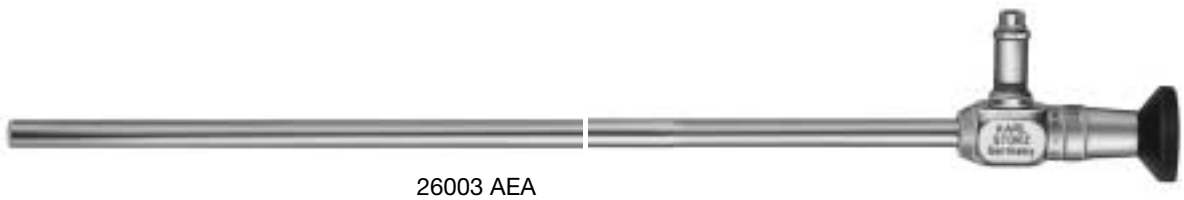
20 1331 01 1 **Cold Light Fountains XENON 300** with built-in antifog air-pump, including mains cord, BNC-connecting cable and silicone tubing set.

26 4320 01 1 **THERMOFLATOR® Set, Insufflation System, consisting of:**
THERMOFLATOR®; mains cord, high pressure tubing for CO_2 gas, German connection; CO_2 bottle, filled; OPTITHERM® heating element; HiCap® trocar, size 13 mm, trocar pyramidal tip, multifunction valve; reducer,13/10 mm; silicone tubing set, sterilizable; universal wrench, CO_2 gas filter, sterile disposable, package of 10.

26 3220 01 1 **LAPAROMAT® Set, Suction and Irrigaiton System, consisting of:**
LAPAROMAT®; mains cord; 3 tubing sets, sterile, disposable; silicone tubing set for irrigation, sterilizable; silicone tubing set for suction, sterilizable; bacterial filter, package of 10, non-sterile; suction bottle, 5 l, sterilizable; bottle cap, for suction bottle, 5 l, sterilizable; bottle holder for suction bottle, 5 l; bottle stand holder for bottle stand.

20 0940 02 1 **KARL STORZ AIDA compact, Basic Set, German** version**, consisting of:**
KARLSTORZ AIDA, control computer, including network card, mouse and sound card; PS/2 keyboard, German; Windows 2000 operating system, pre-installed; AIDA compact software, version 1.x, pre-installed; frame grabber board; headset; extension cable for headset, length 1000 cm; S-VHS (Y/C) connecting cable, length 180 cm; Y-Adaptor for connection to ACC sockets of KARL STORZ camera control units; 2 interface cables, mains cord.

HOPKINS® II Laparoscopes



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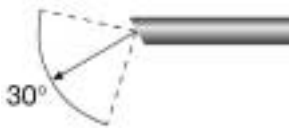
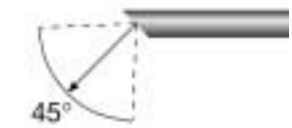


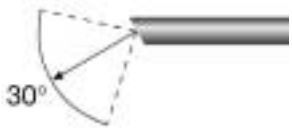
26003 BA HOPKINS II® **Forward-Oblique Telescope** 30°, enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red,

or:



26003 FA HOPKINS II® **Forward-Oblique Telescope** 45°,enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: black.

Optional overlength HOPKINS II® telescopes:



26003 BEA HOPKINS II® **Forward-Oblique Telescope** 30°, enlarged view, diameter 10 mm, length **42 cm,autoclavable,** fiber optic light transmission incorporated, color code: red.

TERNAMIAN **EndoTIP™ Cannulas**

30103 MTR TERNAMIAN **EndoTIP™ Cannula, size 11 mm,**
color code: green,
consisting of:
30103 T4 **Cannula** with thread and rotatable insufflation stopcock, **length 10.5 cm.**
30103 M1 **Multifunctional Valve,** size 11 mm.

31103 MTR TERNAMIAN **EndoTIP™ Cannula, size 11 mm,**
color code: green-red,
consisting of:
31103 T4 **Cannula** with thread and rotatable insufflation stopcock, **length 15 cm,**
30103 M1 **Multifunctional Valve,** size 11 mm.

30108 MTR TERNAMIAN **EndoTIP™ Cannula, size 13 mm,**
color code: blue,
consisting of:
30108 T4 **Cannula** with thread and rotatable insufflation stopcock, **length 11.5 cm,**
30108 M1 **Multifunctional Valve,** size 13 mm.

31108 MTR TERNAMIAN **EndoTIP™ Cannula, size 13 mm,**
color code: blue-red,
consisting of:
31108 T4 **Cannula** with thread and rotatable insufflation stopcock, **length 15 cm,**
30108 M1 **Multifunctional Valve,** size 13 mm.

30140 HB

30142 HB

30140 HB **Reducer,** 13 mm/5 mm.
30142 HB **Double Reducer,**
13 mm/10 mm and 13 mm/5 mm.

Liver Retractor

The liver retractor can be activated by rotation of the proximal part of the handle.

During Roux-en-Y bypass procedures the liver retractor is introduced through the 11 mm-port and placed below the right costal arch. Once securely attached to an instrument holder and firmly fixed in position, the liver retractor can be used to elevate the greater omentum. In this way it is also possible to use the liver retractor for exposure of the hiatal region.

30623 URL **Liver Retractor,** size 10 mm,
large contact surface, length 36 cm.

Adjustable Holder

for fixation of telescopes and sheaths

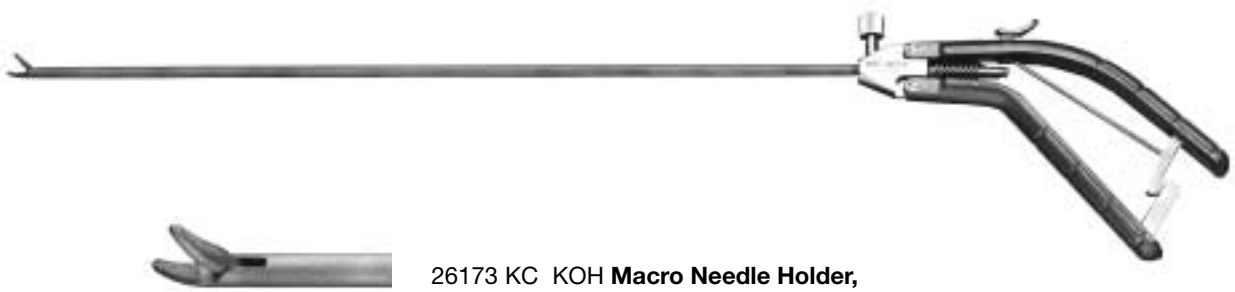
28172 S **Adjustable Holder,** for fixation of telescopes and sheaths
consisting of:
28172 HS **Articulated Arm,** only.
28172 HR **Rotatable Lever** for fixation to operating table.
28172 US **Holder** for fixation of telescopes and sheaths ranging in size 4.8 mm – 12.5 mm

KOH **Macro Needle Holder**

Special features:

- **Tungsten carbide inserts for firm and reliable needle positioning.**
- **Smoothly going, precisely adjustable ratchet for easy and safe positioning of the needle.**
- **Ergonomically designed handle for precise and tension free working.**

The ergonomic 5 mm KOH Macro Needle Holder is specifically designed for accurate grasping and safe positioning of both needle and suture. 7-0 to 0-0 suture material can be handled with ease and accuracy using the precision jaw configuration and new locking mechanism.



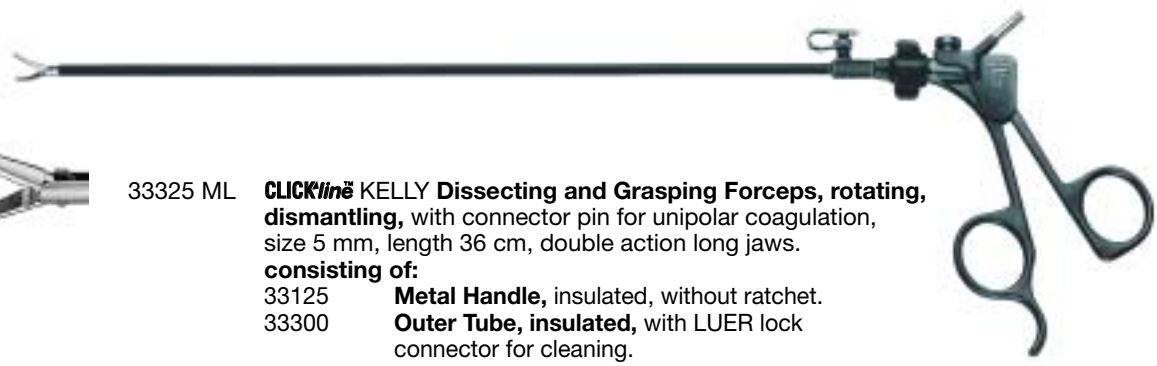
26173 KC KOH **Macro Needle Holder,**
ergonomic handle with ratchet,
jaws curved right, size 5 mm, length 33 cm,
for use with suture material size 0/0 to 7/0.

CLICK*line* Dissecting and Grasping Forceps

33533 BLS **CLICK*line*** BABCOCK **Clamp, rotating, dismantling,** rounded, long jaws, metal handle with hemostat style ratchet, size 5 mm, length 36 cm
consisting of:
33133 **Metal Handle** with hemostat style ratchet.
33500 **Outer Tube, insulated,** with LUER lock connector for cleaning.
33510 BLS **Forceps Insert.**

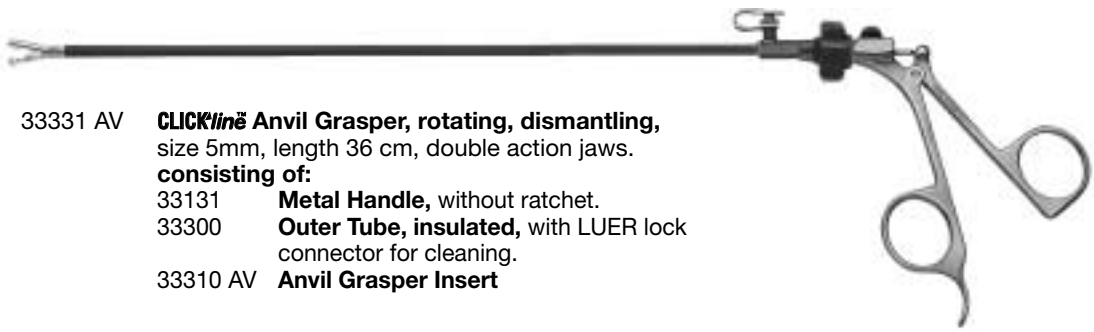
33500 CM **CLICK*line*** **Metal Outer Tube** with cm-marking, size 10 mm, length 36 cm, for use with forceceps insert 33510 BLS.

33333 ON **CLICK*line*** **Grasping Forceps, rotating, dismantling,** with especially fine serration, fenestrated, size 5 mm, length 36 cm.
consisting of:
33133 **Metal Handle** with hemostat style ratchet.
33300 **Outer Tube, insulated,** with LUER lock connector for cleaning.
33310 ON **Forceps Insert.**

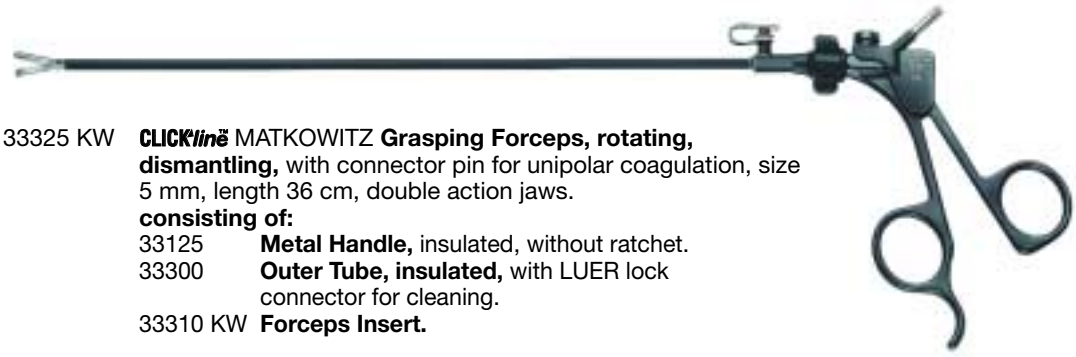


33325 ML **CLICK*line*** KELLY **Dissecting and Grasping Forceps, rotating, dismantling,** with connector pin for unipolar coagulation, size 5 mm, length 36 cm, double action long jaws.
consisting of:
33125 **Metal Handle,** insulated, without ratchet.
33300 **Outer Tube, insulated,** with LUER lock connector for cleaning.
33310 ML **Forceps Insert.**

CLICK'*line* Forceps and Scissors

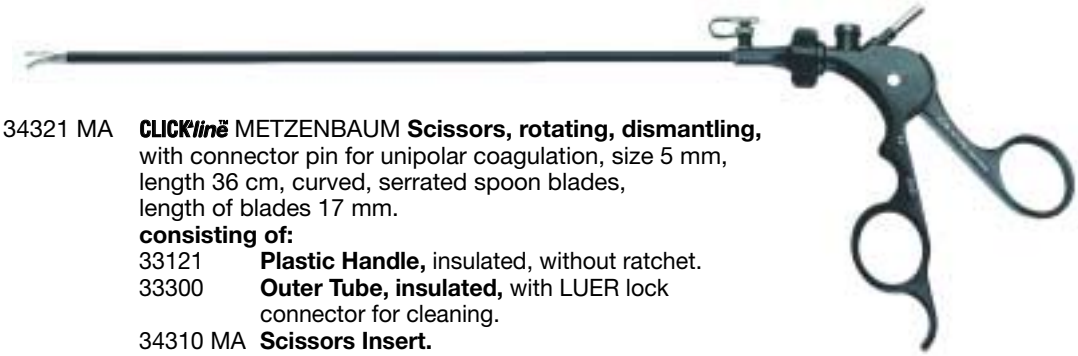


33331 AV **CLICK'*line* Anvil Grasper, rotating, dismantling,** size 5mm, length 36 cm, double action jaws.
consisting of:
33131 **Metal Handle,** without ratchet.
33300 **Outer Tube, insulated,** with LUER lock connector for cleaning.
33310 AV **Anvil Grasper Insert**



33325 KW **CLICK'*line* MATKOWITZ Grasping Forceps, rotating, dismantling,** with connector pin for unipolar coagulation, size 5 mm, length 36 cm, double action jaws.
consisting of:
33125 **Metal Handle,** insulated, without ratchet.
33300 **Outer Tube, insulated,** with LUER lock connector for cleaning.
33310 KW **Forceps Insert.**

33300 CM **CLICK'*line* Outer Tube** with cm-marking, insulated, size 5 mm, length 36 cm, for use with forceps insert 33310 KW.



34321 MA **CLICK'*line* METZENBAUM Scissors, rotating, dismantling,** with connector pin for unipolar coagulation, size 5 mm, length 36 cm, curved, serrated spoon blades, length of blades 17 mm.
consisting of:
33121 **Plastic Handle,** insulated, without ratchet.
33300 **Outer Tube, insulated,** with LUER lock connector for cleaning.
34310 MA **Scissors Insert.**

Coagulation and Dissecting Electrodes

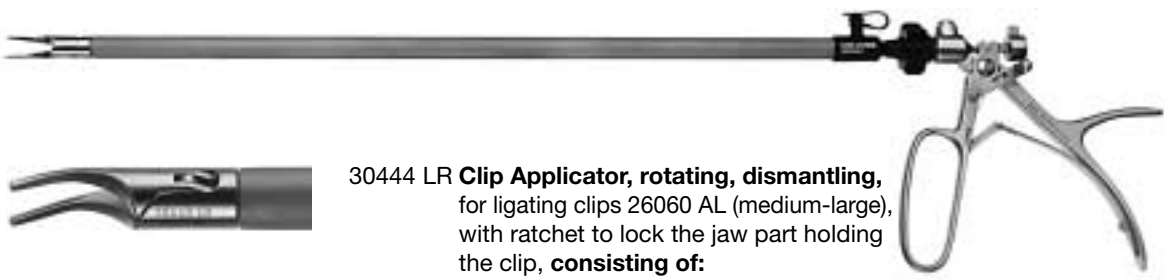
Special Features:
- **Exchangeable eletrode tips**
- **Ergonomic design**

30775 UF

30775 UF **Coagulation and Dissecting Electrode,** L-shaped, insulated, with connector pin for unipolar coagulation, size 5 mm, length 36 cm.

30775 UFE **Exchangeable Electrode Tips,** L-shaped, package of 6 pcs.

Clip Applicator, rotating, dismantling



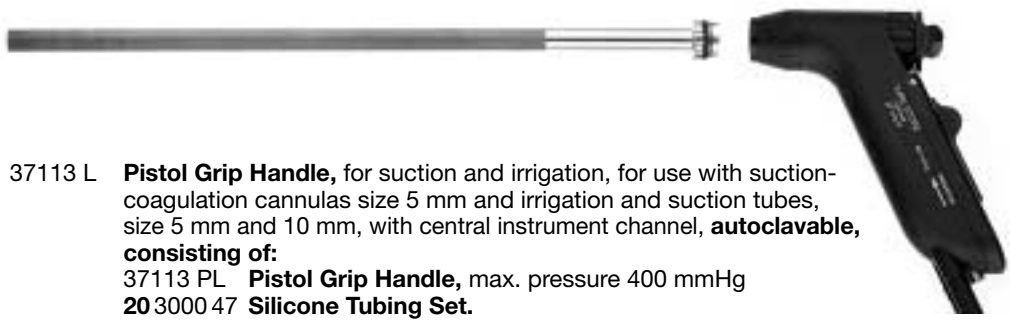
30444 LR **Clip Applicator, rotating, dismantling,** for ligating clips 26060 AL (medium-large), with ratchet to lock the jaw part holding the clip, **consisting of:**
30444 H **Metal Handle** with ratchet.
30444 A **Metal Outer Tube.**
30440 LR **Insert** for ligating clips 26060 AL.

Natural Size

26060 AL PILLING **Titanium Clips,** medium-large, sterile box with 16 cartridges, 10 clips each, for use with clip applicator 30444 LR.

Please note:
The use of other clips than indicated above can lead to damage of the mouthpiece.

Handles for Irrigation and Suction



37113 L **Pistol Grip Handle,** for suction and irrigation, for use with suction-coagulation cannulas size 5 mm and irrigation and suction tubes, size 5 mm and 10 mm, with central instrument channel, **autoclavable, consisting of:**
37113 PL **Pistol Grip Handle,** max. pressure 400 mmHg
20 3000 47 **Silicone Tubing Set.**

Accessories:

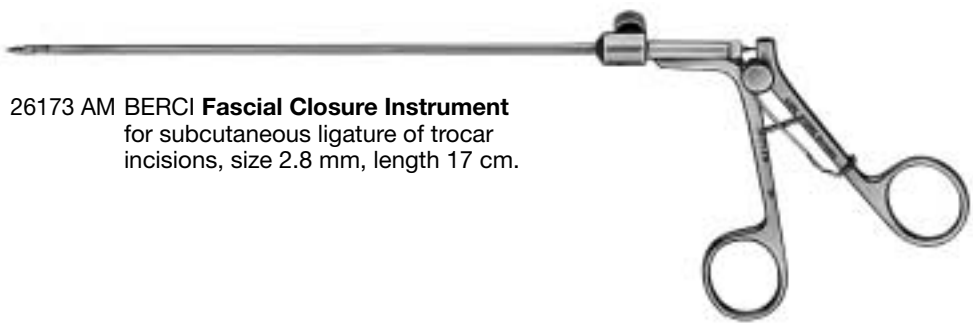
27656 B **Oil Bottle**, 50 ml, for use with handles 37113 PL/PH and 37112 GL/GH.

37360 LH **Irrigation and Suction Tube,** with lateral holes, size 5 mm, length 36 cm.

37560 LH **Irrigation and Suction Tube,** with lateral holes, size 10 mm, length 36 cm.

BERCI **Fascial Closure Instrument**

for subcutaneous ligature of trocar incisions



26173 AM BERCI **Fascial Closure Instrument** for subcutaneous ligature of trocar incisions, size 2.8 mm, length 17 cm.

Fahrbare Gerätewagen

29003 NA **Mobile Video Cart, consisting of:**
29003 NAG **Basic Mobile Cart,** rides on 4 antistatic double-casters, 2 equipped with locking brakes, 1 shelf fixed, 1 shelf with mains switch, 1 shelf inclinable, 1 drawer unit with lock, 1 push bar, with large lumen cable channels integrated in both columns, 4 sets of non-sliding stands, 1 camera mount.
29003 PB **Power-Box** with electrical supply terminal strip with 12 plugs, 12 equipotential plugs,
Dimensions:
Mobile Cart:
700 mm x 1280 mm x 686 mm (w x h x d)
Shelf: 630 mm x 480 mm (w x d)
Caster diameter: 125 mm

29003 NT **Adjustable Arm,**
can be mounted either on the left or on the right side, swivelling range **400 mm,** for mounting of 15" touch screen monitor **20** 0901 02 and **20** 0901 04, consisting of:
29003 MTG **Monitor Carrier**
29003 HK **Adjustable Arm.**

29003 NTL **Adjustable Arm,**
can be mounted either on the left or on the right side, swivelling range **600 mm,** for mounting of 15" touch screen monitor **20** 090102 and **20** 090104, **consisting of**
29003 MTG **Monitor Carrier**
29003 HL **Adjustable Arm.**

29003 GP **Counterbalance Plate,**
provides for secure standing position while mounting the adjustable arm, width 630 mm, for use with mobile videocart 29003 NA/NE/NEA/WEA.

IMAGE 1™

THE SOURCE OF IMAGING

The First Truly Digital Endoscopic Video Camera System

Color Systems PAL, NTSC

Special Features:

- **Digital source sampling** of the image immediately after the CCD sensor-chip minimizes image artifacts, and maximizes high-fidelity image transmission.
- **Digital signal processing** improves image quality even more by providing contrast enhancement and fiberscope filtration for rigid, semi-rigid and flexible endoscopes.
- **Parfocal optical zoom** enhances cross-specialty standardization by providing the optimal image size for all telescopes. Simplified control reduces camera movement to protect the endoscope lens from soiling and damage.
- **Built-in auto-exposure system** instantaneously responds to changes in scene illumination for a seamless transition from one exposure to the next, regardless of the site of the scope or the illumination conditions available.
- **One CCU for all camera heads,** single or three-chip, minimizes procedure start-up and maximizes standardization across all specialties. **Common design characteristics** from camera head to camera head ensure consistent familiarity, so all members of the operating team can more efficiently use the whole system.
- With a **compact profile** and **reprogrammable easy-access buttons,** the **ergonomically designed camera head** provides intuitive, sterile field access to all camera operations. This puts you in command at the press of a button.
- The inherent specific parameters of each ***IMAGE 1™*** camera head are automatically communicated to the CCU: **standardized plug-and-play connectivity** optimizes optical conditions for any user-defined camera head-CCU configuration.
- The **buttonless CCU front panel** delivers complete control to the camera head, reducing the learning curve, setup time, and parameter adjustment.
- The **streamlined card edge connector** has been redesigned to ensure proper insertion for minimized damage to the connector.
- **KARL STORZ Communication Bus (SCB)** displays insufflator, light source and other critical device information directly on the endoscopic monitor to keep the surgical team focused and informed.

***IMAGE 1™ S1* Single-Chip Camera Head**

IMAGE 1™ S3 Three-Chip Camera Head

***IMAGE 1™* Camera Control Unit** including **KARL STORZ Communication Bus System (SCB)** and **Integrated Digital Image Processing Module.** Additional modules are adapted to the customer's individual requirements or can be adjusted to the application intended.

IMAGE 1™

THE SOURCE OF IMAGING

The First Truly Digital Endoscopic Video Camera System

Color Systems PAL, NTSC

22 2200 30-3 ***IMAGE 1™* Three-Chip Camera Head,** color system **PAL.**

22 2201 30-3 **Same,** color system **NTSC.**

22 2100 30-3 ***IMAGE 1™* Single-Chip Camera Head,** color system **PAL.**

22 2101 30-3 **Same,** color system **NTSC.**

IMAGE 1™
Camera Control Unit Basic

22 2000 11 U 1 ***IMAGE 1™* Camera Control Unit Basic,** with **integrated KARL STORZ Communication Bus System (SCB) and Digital Image Processing Module,** including mains cord, keyboard, 2 connecting cables for video printer / video recorder, BNC connecting cable, length 180 cm; S-VHS (Y/C) connecting cable, length 180 cm, special RGB-connecting cable, length 180 cm; SCB connecting cable, length 100 cm.

IMAGE 1™
with DV Module

22 2000 11 U 101 ***IMAGE 1™* Camera Control Unit Basic,** with integrated **KARL STORZ Communication Bus System (SCB), DV-Module and Digital Image Processing Module,** induding mains cord, keyboard, 2 connecting cables for video printer / video recorder, BNC connecting cable, length 180 cm; S-VHS (Y/C) connecting cable, length 180 cm, special RGB connecting cable, length 180 cm; SCB connecting cable, length 100 cm.

IMAGE 1™
with SDI Module

22 2000 11 U 102 ***IMAGE 1™* Camera Control Unit Basic,** with **integrated KARL STORZ Communication Bus System (SCB), Digital Image Processing Module** and **SDI module,** including mains cord, keyboard, 2 connecting cables for video printer / video recorder, 3 BNC connecting cables, length 180 cm; S-VHS (Y/C) connecting cable, length 180 cm, special RGB connecting cable, length 180 cm; SCB connecting cable, length 100 cm.

IMAGE 1™
with SDI / DV Module

22 2000 11 U 104 ***IMAGE 1™* Camera Control Unit Basic,** with **integrated KARL STORZ Communication Bus System (SCB), Digital Image Processing Module, SDI/DV module,** including mains cord, keyboard, 2 connecting cables for video printer / video recorder, 3 BNC connecting cables, length 180 cm; S-VHS (Y/C) connecting cable, length 180 cm, special RGB connecting cable, length 180 cm; SCB connecting cable, length 100 cm; DV cable, length 500 cm.

Cold Light Fountains and Accessories
for photo / video documentation

495 NCS **Fiber Optic Light Cable,**
4,8 mm Ø, Länge 250 cm.

Cold Light Fountain XENON 300

20 1331 01 **Cold Light Fountain XENON 300**
with built-in antifog air-pump
power supply:
100–125 VAC/220–240 VAC, 50/60 Hz
including:
400 A **Mains Cord**
536 MK **BNC Connecting Cable,**
length 180 cm.
610 AFT **Silicone Tubing Set,** autoclavable,
length 250 cm.

20 1330 27 **Spare Lamp Module XENON**
with heat sink, 300 watt, 15 volt.

20 1330 28 **XENON Spare Lamp,** only, 300 watt, 15 volt,

DVCAM Video Recorder
Color Systems PAL / NTSC

544 EP **DVCAM Video Recorder,**
color systems: recording and playback **PAL,**
power supply: 220–240 V CA, 50/60 Hz, 12 VDC,
including mains cord, cleaning cassette and remote control 544 ER.

544 EN **Same,** color system **NTSC.**

KARL STORZ 15" Touch Screen Monitor

20 0901 03 **KARL STORZ 15" Touch Screen Monitor,**
stand-mounted, max. resolution 1024 x 768,
screen: **38 cm/15",** color systems **PAL, NTSC,**
power supply: 100–240 VAC, 50/60 Hz,
consisting of:
400 A **Mains Cord**
20 0901 31 **KARL STORZ 15" Touch Screen Monitor,** including RS-232 cable
20090182 **Power Pack** for **20** 0901 31.
400 A **Mains Cord**

20 0901 02 **Same,** wall bracket-mounted.

LAPAROMAT®

Suction and Irrigation System

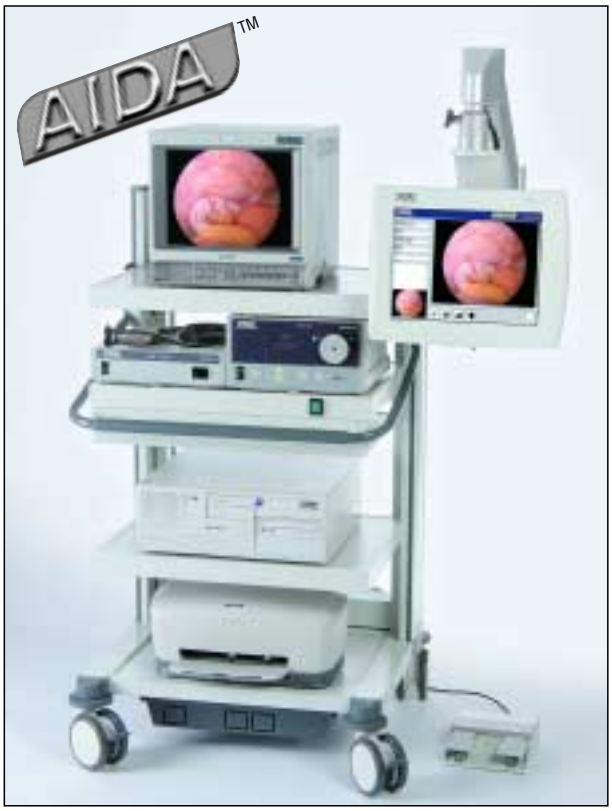
26 3220 01 **LAPAROMAT®,**
suction and irrigation system, German connection, CO_2-bottle filled,
power supply: 100–240 VAC, 50/60 Hz,
including:
26 3220 20 **LAPAROMAT®, Suction and Irrigation System**
400 A **Mains Cord.**
without No. 3 **Tubing Sets,** sterile, disposable.
20 3200 41 **Silicone Tubing Set** for irrigation, sterilizable.
20 3000 42 **Silicone Tubing Set** for suction, sterilizable.
without No. **Bacterial Filter,** non-sterile, package of 10.
20 3000 50 **Suction Bottle,** 5 l, sterilizable.
20 3000 34 **Bottle Cap** for suction bottle, 5 l, sterilizable.
20 3000 32 **Bottle Stand** for suction bottle, 5 l,
20 3000 33 **Bottle Stand Holder** for bottle stand **20** 3000 32.

THERMOFLATOR®

with Speed-Flow Insufflation (30 l/min.) and OptiTherm® heating element 37°

26 4320 01 **THERMOFLATOR®**
with German connection, CO_2-bottle filled,
power supply: 100–240 VAC, 50/60 Hz,
including:
26 4320 20 **THERMOFLATOR®, Insufflation pump**
20 4000 21 **High Pressure Hose,** American connection/ German connection, length 55 cm
26 4000 92 **CO_2-bottle,** filled, German connection.
400 A **Mains Cord.**
20 4320 30 **OptiTherm Heating Element.**
30107 LP **HiCap-Trocar,** consisting of: trocar with pyramidal tip, cannula without valve with HiCap connection for insufflation, length 11.5 cm, multifunctional valve, size 13 mm and reducer 13/10 mm.
20 4000 43 **Silicone Tubing Set,** sterilizable
20 4000 30 **Universal Wrench**
without No. **CO_2 Gas Filer,** sterile, disposable, package of 10.

Please note:
For fully utilizing the maximum insufflation capacity of KARL STORZ THERMOFLATOR®, telescopes and instruments, **size 10 mm** should only be used in combination with a **HiCap®-Trocar, size 13 mm** and **Reducer 13 mm/10 mm**. For instruments, **size 5 mm** a **HiCap®-Trocar, size 11 mm** with reducer is available.



AIDA™

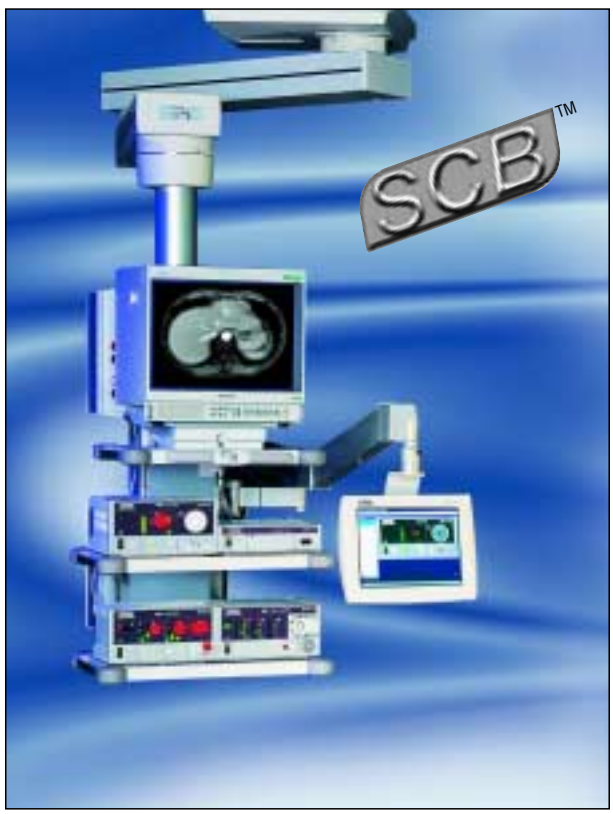
Advanced Image and Data Archiving System

The **KARL STORZ AIDA** series of products offers convenient archiving options of intraoperatively recorded endoscopic images and video sequences.

Depending on which **AIDA** version is used, the images acquired during the surgical procedure can be combined with a patient and treatment data management system or can be archived in the file system.

Special features:

- **Digital Storage.**
- **Real-time display of camera image (Live mode).**
- **Database archiving (clear management of patient and personnel data, doctor's letters, reports, and treatment-specific image data), integratable in the Hospital Information System.**
- **File system (folder structure automatically created according to patient/procedure).**
- **Integration of image files in software applications for preparing training sessions, presentations, and for documentation of treatment progression.**
- **Integration in hospital information system (HIS).**
- **Networking of several AIDA systems.**
- **Recording of still images, video images, voice comments.**
- **Touch screen control.**
- **Sterile operation of recording function using footswitch or camera head buttons.**



SCB

The KARL STORZ Communication Bus System (SCB) sets new standards of enhanced efficiency in the OR

SCB allows all functions to be centrally controlled from within the sterile area and continually monitored during the operation.

The modular design and open architecture concept of the **SCB** system leave practically nothing to be desired, neither in terms of device technology nor user convenience. The surgeon can design his or her personal **SCB** tower according to individual needs and preferences – from the compact starter set-up to the voice-controlled high-end configuration.

Special features:

- **Modular design.**
- **Networking of all KARL STORZ units into a unified system.**
- **Other units, such as OR lamps and tables, data storage devices, etc., can also be integrated by means of the SCB interface.**
- **High degree of system safety and reliability, since the individual units can also be manually controlled in a conventional fashion.**
- **Refitting of your existing equipment is possible; please inquire.**

KARL STORZ AIDA™ compact

Advanced Image and Data Archiving System

Special Features:

- **Compact, digital alternative to video printer, video recorder, dictaphone.**
- **Digital storage of still images, video sequences, and audio files.**
- **Sterile, ergonomic control via touch screen, camera head function keys or footswitch.**
- **Documentation using two self-explaining input masks.**
- **Automatic creation of standard records.**
- **Archiving to CD-ROM.**
- **Computers and monitors certified for use in OR environment according to EN 60601-1.**

Technical specifications:

Video systems:	**PAL, NTSC**
Signal inputs:	**S-VHS, Composite**
Freeze frames:	**JPEG, BMP**
Videos:	**MPEG1/2, AVI**
Audio:	**WAV**

20 0940 02 U **KARL STORZ AIDA compact Basis-Set,** English version, **consisting of:**

20 0934 20	**KARL STORZ AIDA, Control Computer,** including mouse, sound card and network card.
20 0902 32	**PS/2 Keyboard,** English.
20 0902 36	**Windows 2000 Operating System,** pre-installed.
20 0404 01-09	**Software AIDA compact,** Version 1.x, pre-installed.
20 0402 77	**Frame Grabber Board**
20 0900 38	**Headset**
20 0900 76	**Extension Cable** for headset, length 1000 cm.
547 S	**S-VHS (Y/C)-connecting cable,** length 180 cm**.**
20 0401 72	**Y-Adaptor** for connection to ACC sockets of KARL STORZ Endovision camera control units.
20 2210 70	**Interface Cable,** (2x)
400 A	**Mains Cord.**