LAPAROSCOPIC FUNDOPICATION
FOR THE TREATMENT OF
GASTROESOPHAGEAL REFLUX DISEASE

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1.0 Introduction

Gastroesophageal reflux disease has become a major public health problem in our industrialized society. Up to 40% of the U.S. population claim to have at least one episode of heartburn every month. It is reasonable to assume that approximately 10% of the population of industrialized countries seek therapeutic help for reflux-related complaints at some time, and that 10% of this subpopulation suffer from a severe form of reflux disease. This benign functional disorder of the gastrointestinal tract is based on the excessive reflux of gastric juice and gastric contents into the esophagus, causing damage to the esophageal mucosa and/or clinical complaints. Reflux disease can produce a variety of complaints, due in part to its multifactorial etiology, leading to clinical and diagnostic uncertainties that even make it difficult to establish a precise definition for the disease.

Today, reflux disease has become a focal point of interest owing to three main developments that have taken place during the last 10 years:

- The development of proton pump inhibitors, which provide a very efficient medical therapy.
- The development of laparoscopic surgery, which provides an attractive alternative to open surgery.
- The link between long-standing reflux disease and the development of Barrett esophagus, which is at increased risk for malignant transformation.

In this booklet we will explore the various aspects of gastroesophageal reflux disease, review current surgical treatment options, and offer recommendations on techniques and instrumentation.

2.0 Historical Development of Surgical Procedures for the Treatment of Gastroesophageal Reflux Disease

In the past, the frequent link between reflux disease and the presence of a hiatal hernia was considered proof that the anatomical changes associated with the hiatal hernia were solely responsible for the reflux disease. Accordingly, surgical efforts in the early decades of the 20th century and even during the 1960s and 1970s were directed mainly toward restoring the anatomy of the gastroesophageal junction. We do not know who performed the first antireflux operation in the early part of the 20th century.

The first surgical techniques for restoring an anatomically intact gastroesophageal junction were popularized in the early 1950s by Allison. His procedure involved a left transthoracic approach, an incision in the hernial sac or phrenoesophageal membrane, and a counterincision in the diaphragm, allowing the herniated part of the stomach to be pulled back into the abdomen to correct the hernia. While it was later found that the reconstruction of an anatomically normal gastroesophageal junction did lower the pressure level in the lower esophageal sphincter to some degree, it was also found that 50% of the patients continued to have abnormal gastroesophageal acid reflux. Allison himself reported this high failure rate in a retrospective survey of his cases published in the early 1970s, at the end of his career.

Belsey introduced a refined and modified version of the Allison operation in which the esophagus was mobilized without incision of the diaphragm, and the distal esophagus (lower esophageal sphincter region) was attached to the gastric fundus and diaphragm to reduce and stabilize the hernia. This operation was successfully performed by the Belsey and Skinner school in many hundreds of patients.
Perhaps the most widely practiced antireflux operation is the Nissen fundoplication. Rudolf Nissen excised a distal esophageal ulcer in a patient in 1936, then pulled the gastric fundus upward and wrapped it around the oversewn excision site\textsuperscript{54}. On seeing this patient again more than 15 years later, he learned that the patient had been completely free of reflux complaints. This led Nissen to perform a fundoplication in two more patients in the mid-1950s, involving the placement of a complete fundic wrap around the region of the lower esophageal sphincter. He published these cases in 1956 and subsequently performed the operation in many hundreds of patients. Later the Nissen fundoplication was modified in many different variants\textsuperscript{17, 19, 20, 34, 39, 62, 68}.

A familiar modification is the Nissen-Rossetti fundoplication, which in its original version did not include mobilization of the greater curvature. Two sutures were used to fix the anterior part of the fundoplication to the anterior gastric wall\textsuperscript{62}.

Authors devised and advocated a variety of pexy techniques in the belief that gastroesophageal reflux disease was caused less by an incompetent lower esophageal sphincter than by weakening of the antireflux barrier due to a lack of longitudinal esophageal tension, leading to deficient spiral fiber closure of the distal esophagus\textsuperscript{49, 77}. Unfortunately, the simple anatomic reconstruction of a hiatal hernia and restoration of longitudinal tension to the esophagus by a gastropexy, fundoplicoplasty, or posterior gastropexy as advocated by Hill, as well as ligamentum teres plasty, yielded disappointing results with a relatively high rate of recurrent reflux. As a result, all but a few of these procedures were subsequently abandoned\textsuperscript{36, 40}.

While plastic implants for the repair of diaphragm defects were already being tested in the early 1960s, Angelchick was the first to develop a successful antireflux prosthesis that was placed around the gastroesophageal junction\textsuperscript{4, 35, 37}. Material problems led to some unusual complications in the initial phase, which were subsequently corrected. One problem remained, however: an unacceptably high rate of persistent postoperative dysphagia, making it necessary to remove the prosthesis in a reported 10–15% of cases\textsuperscript{47, 48, 70, 76}.

The Angelchick prosthesis has been successfully used in the U.S., but it has not been widely employed in Europe.

### 3.0 Clinical Aspects of Gastroesophageal Reflux Disease

Although the dominant clinical features of reflux disease are specific symptoms such as heartburn and regurgitation, careful questioning of most patients will elicit a broad spectrum of additional symptoms.

The classic symptom of gastroesophageal reflux disease is heartburn, which is present in 68–85% of reflux patients. Formerly, two types of patients were distinguished based on the circadian timing of their heartburn: "upright refluxers," who experience postprandial reflux complaints and belching throughout the day, and "supine refluxers," who experience reflux complaints mainly after retiring at night. A very characteristic symptom is regurgitation. It differs from vomiting by the absence of associated symptoms such as nausea, retching, or thoracoabdominal muscle contractions.

Dysphagia is present in up to 30% of patients with reflux disease. By contrast, odynophagia, or painful swallowing, is a relatively rare symptom\textsuperscript{45}. Both symptoms frequently result from a peptic stricture in reflux patients. In rare cases they are caused entirely by esophagitis, a Schatzki ring, or an esophageal motility disorder.

Epigastric pain is described as the most common symptom of reflux disease. It is combined with heartburn or regurgitation in most patients, but in 10–20% of cases it is the only presenting symptom of reflux disease.
The most common respiratory symptoms of reflux disease are nocturnal awakening with cough and dyspnea, morning hoarseness, and recurrent bronchospastic episodes. These symptoms are often predominant, especially in children. Nausea and vomiting are other nonspecific symptoms. Because they also occur in a variety of diseases in the upper gastrointestinal tract, they serve more as suggestive signs than definitive criteria.

The complications of gastroesophageal reflux disease are erosive esophagitis, strictures, ulcers, and the development of a specialized columnar epithelium with intestinal metaplasia (Barrett esophagus).

Esophagitis is caused by chronic irritation of the esophageal mucosa by gastric juices, resulting in a loss of superficial epithelial cells. Opinions vary as to whether esophagitis is a symptom or a complication of reflux disease, due largely to an overlap in the definition of the terms “reflux disease” and “reflux esophagitis.”

Peptic esophageal stricture results from long-term damage to the esophageal mucosa due to intestinal secretions. It always develops at the junction of squamous epithelium and columnar epithelium.

An esophageal ulcer may develop at the transition zone between columnar and squamous epithelium (“gastroesophageal junction ulcer”), where it usually causes or contributes to stricture formation. Frequently, however, a “Barrett ulcer” will develop in the columnar epithelium of a Barrett esophagus. To date, the very rare complications of penetration or perforation have been observed only in patients with a Barrett ulcer. The underlying pathophysiologic mechanism is an excessive reflux of gastric juice into the esophagus followed by mucosal damage and/or clinical complaints. The variety of complaints that may arise, the multiple causal factors that contribute to abnormal reflux, and the individual resistance of the esophageal mucosa to refluxed material lead to clinical and diagnostic uncertainties which make it difficult to establish a precise definition for the disease. In the past, reflux disease was defined radiographically by the presence of a hiatal hernia at the gastroesophageal junction and the ability to provoke the reflux of contrast medium during x-ray examination. The relationship between hiatal hernia and reflux disease continues to be a controversial issue. The incidence of axial hiatal hernia, usually a sliding form, increases with aging. Most persons with a hiatal hernia do not have abnormal reflux, suggesting that an axial hiatal hernia does not necessarily have pathologic significance in reflux disease. Conversely, it is now known that a hiatal hernia can be detected in approximately 80% of patients with reflux disease, and that the morphologic changes associated with an hiatal hernia can promote a pathologic reflux mechanism.
During the past 20 years, gastroesophageal reflux disease has been defined on the basis of endoscopically detectable reflux esophagitis\textsuperscript{5-65}. But a great many patients suffer from mild or severe reflux complaints in the absence of endoscopically detectable esophagitis, and so we cannot claim that endoscopy provides optimum sensitivity or specificity in defining the disease\textsuperscript{33}. One way to formulate a precise definition of gastroesophageal reflux disease (GERD) is to base the definition on the pathophysiologic mechanism that underlies the disease process. GERD is present when gastric contents enter the esophagus in an abnormal quantity or abnormal composition, leading to specific and nonspecific symptoms and/or damage to the esophageal mucosa. The following definition is in common use: GERD is present when there is risk of organic complications due to increased gastroesophageal reflux and/or quality of life is adversely affected due to reflux-related complaints.

Thus, the diagnosis of GERD relies critically on the precise detection of gastric contents in the esophagus, whether in the form of acidic gastric juice or mixed gastric contents that have refluxed from the duodenum. Owing to diagnostic advances, particularly computer-assisted methods such as 24-hour pH monitoring of the esophagus and stomach, long-term aspiration tests, and fiberoptic measurements of substances originating in the small intestine, the presence of GERD can be confirmed with high accuracy even in patients with nonspecific symptomatology. Researchers have identified three main causal factors for abnormally increased exposure of the esophageal mucosa to gastric contents. The most important of these causal factors is mechanical weakness or incompetence of the lower esophageal sphincter. The second causal factor is an abnormal pumping action of the esophagus due to impaired esophageal peristalsis, and the third is impaired gastric function\textsuperscript{16, 21, 33}. Gastric dysfunction may involve excessive gastric dilatation, impaired gastric emptying with damming back of gastric contents, or abnormally high gastric acid secretion.

Incompetence of the lower esophageal sphincter is the most common functional deficit in GERD patients. A number of different criteria for sphincter incompetence have been published in the literature\textsuperscript{16, 53, 88}. The DeMeester criteria used in our laboratory are outlined in Tab. 1\textsuperscript{27, 88}.

Impaired esophageal peristalsis with abnormal contractions or an abnormal sequence of contractions can compromise the pumping ability of the esophagus, leading to changes detectable by manometry. Detailed cutoff values have been published elsewhere and are summarized in Tab. 1.

\begin{tabular}{|l|c|}
\hline
\textbf{Criteria for incompetence of the lower esophageal sphincter} \\
Total length & $< 2$ cm \\
Intra-abdominal length & $< 1$ cm \\
Sphincter pressure & $< 6$ mmHg \\
\hline
\textbf{Criteria for impaired esophageal peristalsis} \\
Abnormal morphology of contractions \\
Amplitude & $> 180$ mmHg \\
Amplitude & $< 20$ mmHg \\
Duration & $> 7$ s \\
Multiple peaks & \\
Repetitive & \\
\hline
\textbf{Abnormal sequence of contractions} \\
Simultaneous (progression $> 20$ cm/s) & $> 10\%$ of primary contractions do not propagate down the esophagus \\
(ampitude $< 10$ mmHg) & $> 10\%$ of primary contractions are repetitive $> 30\%$ of primary contractions. \\
\hline
\end{tabular}

Tab. 1
Manometric criteria for abnormal esophageal motility.
4.0 The “Antireflux Barrier” and the Pathophysiology of Reflux

When the gastroesophageal junction is inspected endoscopically, it appears narrowed in relation to the overlying tubular esophagus, analogous to the finding on contrast radiographs. This high-pressure zone can be clearly identified by manometry. Hereafter it is referred to as the lower esophageal sphincter (LES).

The mechanisms that make the esophageal mucosa resistant to toxic substances in gastric reflux are not yet fully understood. It has been shown that the mucosa can resist proton penetration along a gradient of 5 pH units. The mucosa within the esophageal lumen secretes a mucous layer whose bicarbonate and water content are resistant to stomach acid. Additionally, salivary glands and the esophageal mucosa can increase bicarbonate ion secretion in response to an increased acid content in the esophageal lumen. The blood flow to the esophageal wall also plays a critical role in maintaining effective epithelial resistance.

For many years, functional abnormalities of the stomach were not recognized in the pathogenesis of GERD. Today we know that abnormalities of gastric secretion and motility may be solely responsible for reflux disease in some cases, but that they usually coexist with an incompetent LES.

Excessive or persistent secretion of gastric acid may caused increased acid exposure of both the gastric lumen and esophageal lumen. Acid is known to have a role in the pathogenesis of esophageal mucosal injury, but pepsin may also be involved. Several groups of authors have found significantly higher levels of gastric acid secretion and a markedly increased incidence of persistent gastric acidity in complicated reflux disease and in Barrett patients than in normal controls.

Antroduodenal motility disorders may lead to abnormal gastroduodenal reflux. With persistent incompetence of the LES, this may increase the toxicity of material that refluxes into the esophagus. Additionally, delayed gastric emptying may further increase the amount of material available for reflux through the incompetent LES. When gastric emptying is delayed in the presence of a competent sphincter, gastric dilatation may occur leading to temporary shortening of the sphincter and increased transient sphincter relaxations, resulting in increased gastroesophageal reflux.

Duodenogastric reflux is another physiologic phenomenon that is analogous to gastroesophageal reflux. When excessive, duodenogastric reflux can produce a mixture of acid, pepsin, pancreatic products, bile acids, and lysolecithin in the gastric lumen. The entry of this material into the esophagus can be very toxic to the esophageal mucosa. It is not surprising, then, that an increased incidence of duodenogastric reflux has been found in patients with peptic strictures and Barrett esophagus.

In summary, GERD should be understood as a multifactorial process (Fig. 4.1).
The most frequent cause of the disease is mechanical incompetence of the LES, which occurs as an isolated condition in almost 50% of GERD patients. Abnormal esophageal peristalsis may be found in 14% of patients but is an isolated disorder in only 2% of cases. The resistance of the esophageal mucosa to harmful intraluminal agents is difficult to assess and is not routinely determined. The variety of possible gastric causes, which are involved in approximately 40% of GERD cases, compounds the difficulty of an accurate diagnostic evaluation. The most common accompanying component is persistent gastric acidity, which may occur as an isolated condition in almost 10% of cases and is combined with other causal factors in more than 25% of cases. It is widely agreed that more than one causal factor is involved, especially in patients with complicated reflux disease33.

5.0 Surgical Treatment Concepts

As the pathophysiology of GERD and the central role of the LES became more clearly understood, various types of fundoplication procedure emerged as the preferred surgical treatment option (Fig. 5.1).

The Nissen fundoplication has traditionally been named for the surgeon that introduced it. It has undergone so many modifications, however, that the precise technique should always be specified in the reporting and analysis of results. A variety of different fundoplication techniques are known today (Fig. 5.1).

The Nissen fundoplication is still the most widely practiced antireflux operation on a worldwide scale. Unfortunately, errors of patient selection and operating technique have led to poor outcomes with the Nissen procedure. Persistent side effects such as dysphagia and gas bloat syndrome have been observed and are most commonly reported after a Nissen fundoplication17, 21, 34, 52, 62, 68, 69. For this reason, some authors have come to favor a partial fundoplication as an alternative to the Nissen complete wrap.
Laparoscopic Fundoplication for the Treatment of Gastroesophageal Reflux Disease

6.0 Indications for Antireflux Surgery

The indications for the surgical treatment of GERD depend on four main factors: the level of patient distress, complications of the disease, the underlying functional defect, and the general condition of the patient\textsuperscript{11, 24, 34}. The first priority is to relieve distress, although this is a subjective parameter. Because GERD is a benign disorder, improving the quality of life is the prime consideration in patient selection. The presence of medically refractory symptoms such as heartburn, regurgitation, or epigastric pain are definite indications for antireflux surgery.

A second factor in patient selection is an advanced form of the disease with associated causal functional deficits in the upper gastrointestinal tract, the need for increased medication doses, and complications of the reflux disease. The latter include persistent esophagitis, strictures, bleeding, ulcers, and the development of a Barrett esophagus in response to reflux\textsuperscript{11}. These cases require surgical therapy for the permanent prevention of reflux.

Patient selection criteria:
Esophagitis, sphincter incompetence, positive pH-metry, mixed reflux, volume reflux, respiratory symptoms, large hiatal hernia, increased dose of PPIs, persistence of typical complaints.

The third selection criterion, and an essential factor, is the general condition of the patient. Because GERD is a benign functional disorder, any significant postoperative morbidity or mortality would be catastrophic. Thus, if the patient is in a debilitated state, it is important to critically weigh the necessity and goal of the operation and the prospect for quality-of-life improvement against the risk of the procedure.
7.0 Nissen-DeMeester Technique of Laparoscopic Fundoplication

The Nissen fundoplication, in which a 360° fundic wrap is placed around the esophagus, has become the most popular antireflux procedure among surgeons since Nissen first described it in 1956. Based on experimental and clinical studies, many surgeons in Europe and the U.S., including the Chicago-based schools of T. R. DeMeester and C. T. Bombeck, have advocated a short, loose wrap called a “floppy Nissen” to prevent unpleasant side effects from the fundoplication. The need to add a posterior hiatalplasty is controversial. The extent of fundic mobilization also varies among different surgeons.

The details of the Nissen-DeMeester technique of laparoscopic fundoplication are described below.

The patient is placed on the operating table in the “French position” with the legs abducted. The foot of the table is lowered during the operation so that the abdominal fat and small and large bowel will sag downward, making it easier to explore the upper abdomen. After the patient has been washed, prepped and draped, a Veress needle is introduced on the midline approximately one-third up the line from the umbilicus to the xiphoid and a pneumoperitoneum is established, maintaining compliance with usual safety tests. A pressure of 10–14 mmHg is set on the Endoflator in adolescents and adults. A pressure of 6–8 mmHg is used in smaller children, depending on body size. A conical trocar is always inserted first. It is rotated into the abdomen rather forcibly introduced. With some experience, the surgeon will be able to develop a “tissue feel” indicating when the trocar has passed through the fascia. This can avoid trocar injuries even in patients whose bowel is close to the abdominal wall. Another option is an open approach to the abdominal cavity.

A 30° endoscope (Fig. 7.2) is recommended for these procedures so that the retroesophageal region and thoracic region will be easily accessible, even with changing trocar sites, during mobilization of the esophagus. Figure 7.1 shows the recommended workplace organization and trocar placement for all necessary access ports.
Additional 11-mm trocars are introduced into the upper abdomen under endoscopic vision (sites are shown in Fig. 7.1). A 13-mm trocar should be placed at the right lateral site if a large-caliber instrument will be used for liver retraction. The organ retractor is introduced through the right lateral port and is used to retract the left lobe of the liver. A grasping forceps is passed through the left lateral port to pull the gastric fundus downward and toward the left side. Initially the stomach and gastroesophageal junction should be carefully inspected, giving particular attention to the width of the hiatus (Fig. 7.3) and possible fixation of the cardia, and thus of the LES, within the thorax. These factors are of major importance in directing the rest of the operation. In a 360° Nissen fundoplication, we favor complete mobilization of the fundus with division and occlusion of the short gastric vessels and posterior mobilization of the retroperitoneal structures so that a loose, tension-free wrap can be placed around the LES. This step is aided by passing a grasping forceps through the right paramedian site to place tension on the right side of the stomach. Another grasper is introduced on the left side to place tension on the gastroplenic ligament. At this point a step-by-step dissection can be performed with an ultrasonic dissector introduced through the left paramedian port (Figs. 7.4, 7.4.1).
Problems may arise if the gastroplenic ligament is very short and the gastric fundus abuts the superior pole of the spleen, leaving very little room for dissection. It is essential at this stage to dissect the left crus of the diaphragm over its entire length (Figs. 7.5–7.5.4).
Working from right to left, the surgeon begins to dissect and free the hiatus by incision of the phrenoesophageal membrane just above the right crus (Fig. 7.6). To spare the vagal nerve branches to the liver and gallbladder, the dissection should begin as high as possible on the hiatal arch and proceed toward the right crus of the diaphragm. The caudate lobe of the liver can be identified on the left side of the field and, behind the retracted lobe, the vena cava.

As in open surgery, the dissection is performed with scissors, grasping forceps, and dissecting sponges. The main goal of the dissection at the gastroesophageal junction is to expose both crura of the diaphragm. A clean dissection of both crura will automatically expose the esophagus as a thick, cordlike structure in the midline. The tissue band transmitting the left and anterior vagal nerve branches is identified (Fig. 7.7). After the right crus of the diaphragm has been completely freed superiorly and further dissection has been completed along the hiatal arch to the left crus of the diaphragm, the last fibrous attachments between the diaphragm crura and esophagus can generally be spread apart with gentle pressure from the grasper and a mounted sponge, providing clear, bloodless access to the lower mediastinum (Fig. 7.8).

It is not unusual to see the posterior vagal trunk on the vertebral column, on the aorta, or even closer to the esophagus (Fig. 7.9).
It may be left alone if it is a good distance from the esophagus, but in most cases it is expedient to leave the nerve near the esophagus and snare it along with the esophagus. After mobilization has been completed in the lower mediastinum and the two vagus nerve branches have been safely exposed along with the diaphragm crus on the left side, a grasping forceps can be passed behind the esophagus from right to left through the gastroesophageal window and advanced into the left upper abdomen to the splenic fossa to pick up a rubber tape, Penrose drain, or easy-flow drain for snaring the esophagus (Figs. 7.10, 7.10.1). Once in place, the snare can be used to manipulate the esophagus into any desired position.
The next step is mobilization of the distal esophagus (Figs. 7.11–7.11.3), allowing the entire lower esophageal sphincter to be advanced into the abdominal cavity. After the completion of all dissection and mobilization, a posterior hiatalplasty is performed using two or three 0 or 2-0 nonabsorbable sutures (Fig. 7.11). The sutures can be tied with extracorporeal knots placed over the right diaphragm crus while the esophagus is retracted to the left.

With a very wide hiatus, it is advisable to add an anterior suture. If the tissues are weak, the crural musculature is thin, or there is a significant residual gap at the hiatus, mesh should be added to ensure a successful repair.
For a 360° fundoplication, the fundus is completely mobilized. The posterior part of the fundus is passed behind the esophagus with a forceps and is grasped with a second forceps on the right side (Fig. 7.12). At this point the wrap is precisely tailored to the lower esophageal sphincter under optimum vision (Fig. 7.13). If the wrap is under tension, this means that the fundus has not been adequately mobilized, and the tension should be relieved by additional mobilization of the fundus. The shortest possible tension-free wrap is then secured over the lower esophageal sphincter with 0 to 2-0 nonabsorbable sutures. As in the DeMeester “sandwich” technique, the sutures are tied over small underlays precut to a size of 1 x 0.5 cm.
During suture placement, a 40–60 Ch gastric tube is passed transorally into the cardia to function as a stent and reduce the risk of postoperative dysphagia. The large gastric tube is replaced at the end of the operation with a transnasal 18 Ch gastric tube.
8.0 Partial Fundoplications

Various modifications of partial fundoplication techniques have been described in the literature. The most popular partial fundoplication at present is the Toupet fundoplication, which is described below. Other examples are the anterior 180° hemifundoplication (Fig. 8.1), the anterior Watson fundoplication, and additional modifications of the Toupet operation using a posterior 180° or 240° wrap (Fig. 8.2). Ordinarily the Toupet posterior partial fundoplication includes mobilization of the gastroesophageal junction and mobilization of the fundus. The preparatory dissection for a Toupet fundoplication is essentially the same as for a Nissen fundoplication: When the fundus has been mobilized and the posterior fundic flap has been pulled through to the right side after completion of the posterior hiataloplasty, the posterior fundic flap is sutured to the right lateral aspect of the esophagus with three nonabsorbable sutures.

The anterior fundic flap is similarly sutured to the left lateral aspect of the esophagus, carefully preserving the anterior vagal nerve branch. Several authors have modified this stage of the operation, but we question the advisability of fixing the fundus to the diaphragm crura with one or two posterior sutures.

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Fig. 8.1
Anterior 180° hemifundoplication.

Fig. 8.2
Toupet operation with a 240° posterior wrap.
9.0 Selecting the Optimum Procedure

Taking the first five years as the average learning period for laparoscopic fundoplication, Tab. 3 shows an overview of the largest prospective studies published between 1993 and 2000. Only studies with case numbers greater than 100 are included in this review. Good results were achieved in 90–97% of the cases, with a recurrent reflux rate of 1–9%. These studies cannot be compared with one another due to varying definitions of complications and problems such as postoperative dysphagia. But by surveying these studies, we can gain a reasonably good idea of the quality of the results. The studies on laparoscopic partial fundoplication report similarly high success rates of up to 92%, although isolated reports in patients with severe reflux disease indicate less favorable results.

Initial comparisons between open and laparoscopic surgery were published in the mid-1990s. These studies consistently reported a shorter recovery period after laparoscopic surgery due to less access trauma. The criteria for these comparative analyses were varied and often related to postoperative analgesic use, the earlier resumption of peristalsis allowing earlier enteric nutrition, and a better cosmetic result. Reports on comparisons of hospital stay and cost-benefit calculations indicate a more favorable result for laparoscopic surgery, particularly in the U.S. Given past reimbursement policies in the German health care system, however, these advantages could neither be determined nor fully utilized because reimbursement was tied to the length of hospital stay. In this respect the cost-benefit ratios could not be transferred from one system to the other.

Valid comparisons can be based upon the measurement of objective parameters such as immune factors and respiratory function. In one nonrandomized comparison, immunologic analyses of interleukin 6, HLA-DR monocytes, and other factors were compared in patients who had undergone open fundoplication and laparoscopic Nissen fundoplication. Postoperative tests showed a rapid and significant rise of IL-6 cytokines and a significant fall of HLA-DR monocytes as indicators of immune status. A significant long-term rise was documented in the open-surgery group of patients compared with the laparoscopic group. Similarly, Olsen et al. found significant differences in various pulmonary function parameters between open and laparoscopic surgery. All the patients had postoperative limitation of respiratory function, but the impairment was significantly less pronounced in the laparoscopic group than in the open-surgery group. These results point to a potentially better initial status of patients who have undergone laparoscopic surgery.

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<td>Feussner</td>
<td>1994</td>
<td>18</td>
<td>16.0</td>
<td>22.0</td>
<td>89.0</td>
<td>0</td>
<td>11.0</td>
</tr>
<tr>
<td>Fuchs</td>
<td>1994</td>
<td>35</td>
<td>6.0</td>
<td>19.0</td>
<td>91.0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Peters</td>
<td>1995</td>
<td>32</td>
<td>0</td>
<td>17.6</td>
<td>84.0</td>
<td>3</td>
<td>9.4</td>
</tr>
<tr>
<td>Dallemagne et al.</td>
<td>1996</td>
<td>240</td>
<td>&lt;2</td>
<td>3.5</td>
<td>96.0</td>
<td>2</td>
<td>2.0</td>
</tr>
<tr>
<td>Fuchs et al. (ESGARS)</td>
<td>1997</td>
<td>221</td>
<td>&lt;5</td>
<td>14.0</td>
<td>93.0</td>
<td>2</td>
<td>2.0</td>
</tr>
<tr>
<td>Perdikis et al.</td>
<td>1997</td>
<td>2453</td>
<td>5.8</td>
<td>7.3</td>
<td>92.0</td>
<td>3</td>
<td>5.5</td>
</tr>
<tr>
<td>Pointner et al.</td>
<td>1998</td>
<td>196</td>
<td>&lt;3</td>
<td>4.0</td>
<td>95.0</td>
<td>1</td>
<td>4.5</td>
</tr>
</tbody>
</table>
Only randomized studies can determine the actual clinical relevance of these findings with regard to patient well-being and the length of follow-up care. Six randomized studies have been published based on a direct comparison of conventional and laparoscopic antireflux operations. Their results are summarized in Tab. 4.

Past studies of open fundoplications in large clinical series documented superior longevity of the Nissen wrap and a slightly higher failure rate with a partial wrap. These findings were initially confirmed in a randomized study, but further randomized comparisons of both open procedures during the past 10 years were unable to confirm these results (Tab. 5) [12, 32, 36, 58, 59, 63, 76]. The latest randomized studies of laparoscopic operations indicate similar success rates. None of the studies showed significant differences between partial and complete fundoplication with regard to postoperative morbidity, recurrent reflux rate, or dysphagia. Overall, a tendency toward greater gas bloat and flatulence was noted in patients who underwent a Nissen fundoplication.

Tab. 4: Overview of randomized studies comparing open and laparoscopy surgery: perioperative data

<table>
<thead>
<tr>
<th>Author Recruitment</th>
<th>Random groups</th>
<th>Morbidity N (%)</th>
<th>Operating time (min.)</th>
<th>Hospital stay (days)</th>
<th>Absence from work (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laine Open 1992-95</td>
<td>Lap 55</td>
<td>7 (13)</td>
<td>57</td>
<td>6.4</td>
<td>37</td>
</tr>
<tr>
<td>Heikkine Open 1995-96</td>
<td>Lap 22</td>
<td>8 (29)</td>
<td>98</td>
<td>3.0</td>
<td>21</td>
</tr>
<tr>
<td>Bais Open 1997-98</td>
<td>Lap 57</td>
<td>9 (17)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Luostarinen Open 1994-95</td>
<td>Lap 13</td>
<td>0</td>
<td>30</td>
<td>5.0</td>
<td>30</td>
</tr>
<tr>
<td>Chrysos Open 1993-98</td>
<td>Lap 56</td>
<td>38 (76)</td>
<td>83</td>
<td>5.9</td>
<td>–</td>
</tr>
<tr>
<td>Nilsson Open 1995-97</td>
<td>Lap 30</td>
<td>0</td>
<td>109</td>
<td>3.0</td>
<td>32</td>
</tr>
</tbody>
</table>

Tab. 5: Overview of randomized studies comparing open and laparoscopy surgery: follow-up care

<table>
<thead>
<tr>
<th>Author Recruitment</th>
<th>Random groups</th>
<th>Patients in follow-up care</th>
<th>Recurrent reflux N (%)</th>
<th>Dysphagia N (%)</th>
<th>Bloating N (%)</th>
<th>Reoperation N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laine Open 1992-95</td>
<td>Lap 55</td>
<td>30 (12mo)</td>
<td>3 (10)</td>
<td>4 (13)</td>
<td>2 (7)</td>
<td>0</td>
</tr>
<tr>
<td>Heikkinen Open 1995-96</td>
<td>Lap 22</td>
<td>19 (24mo)</td>
<td>2 (11)</td>
<td>11 (58)</td>
<td>10 (53)</td>
<td>0</td>
</tr>
<tr>
<td>Bais Open 1997-98</td>
<td>Lap 57</td>
<td>46 (3mo)</td>
<td>1 (2)</td>
<td>0</td>
<td>3 (4)</td>
<td>4 (7)</td>
</tr>
<tr>
<td>Luostarinen Open 1994-95</td>
<td>Lap 13</td>
<td>13 (17mo)</td>
<td>0</td>
<td>6 (46)</td>
<td>–</td>
<td>0</td>
</tr>
<tr>
<td>Chrysos Open 1993-98</td>
<td>Lap 56</td>
<td>50 (12mo)</td>
<td>1 (2)</td>
<td>2 (4)</td>
<td>3 (6)</td>
<td>0</td>
</tr>
<tr>
<td>Nilsson Open 1995-97</td>
<td>Lap 30</td>
<td>23 (60mo)</td>
<td>4 (17)</td>
<td>5 (22)</td>
<td>10 (43)</td>
<td>1 (4)</td>
</tr>
<tr>
<td>1994-95</td>
<td>Lap 30</td>
<td>17 (60mo)</td>
<td>2 (12)</td>
<td>7 (41)</td>
<td>8 (47)</td>
<td>2 (12)</td>
</tr>
</tbody>
</table>
Comparison: Division of the Short Gastric Vessels

The advantage or disadvantage of dividing the short gastric vessels is a controversial issue among surgeons and has been investigated in several randomized studies. Some of these studies employed different definitions for fundic mobilization, and this definitely limits our ability to interpret the study results. The data from the randomized studies is summarized in Tab. 6. No significant differences were reported in terms of postoperative morbidity, dysphagia, or recurrent reflux rate.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Method</th>
<th>N</th>
<th>Morbidity</th>
<th>Follow-up care, months</th>
<th>Recurrent reflux</th>
<th>Dysphagia</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeMeester</td>
<td>1974</td>
<td>Open Nissen</td>
<td>15</td>
<td>2/15</td>
<td>84</td>
<td>0/4</td>
<td>0/4</td>
</tr>
<tr>
<td>Thor</td>
<td>1989</td>
<td>Open Nissen</td>
<td>12</td>
<td>3/12</td>
<td>60</td>
<td>5/12</td>
<td>4/12</td>
</tr>
<tr>
<td>Lundell</td>
<td>1996</td>
<td>Open Nissen</td>
<td>65</td>
<td>0/65</td>
<td>36</td>
<td>3/62</td>
<td>6/62</td>
</tr>
<tr>
<td>Walker</td>
<td>1992</td>
<td>Open Nissen</td>
<td>26</td>
<td>8/26</td>
<td>13</td>
<td>0/26</td>
<td>2/26</td>
</tr>
<tr>
<td>Laws</td>
<td>1997</td>
<td>Laparoscopic Nissen</td>
<td>23</td>
<td>0/23</td>
<td>27</td>
<td>1/23</td>
<td>0/23</td>
</tr>
<tr>
<td>Watson</td>
<td>2004</td>
<td>Laparoscopic Nissen</td>
<td>53</td>
<td>8/53</td>
<td>60</td>
<td>1.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Zornig</td>
<td>2001</td>
<td>Laparoscopic Nissen100</td>
<td>–</td>
<td>6</td>
<td>18/93</td>
<td>30 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Laparoscopic Toupet100</td>
<td>–</td>
<td>6</td>
<td>10/95</td>
<td>11 %</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 6: Randomized comparison of complete and partial fundoplication

10.0 Discussion

More than a decade after the introduction of minimally invasive surgical technique, considerable data have been published on the advantages of laparoscopic surgery over conventional surgery. These data require a differentiated analysis, however. Available studies show that the laparoscopic technique leads to a significant reduction of perioperative morbidity and postoperative hospital stay and less immune compromise compared with open antireflux surgery. The long-term functional result is similar after both types of surgery when the operations are performed at an experienced center.

The “experience” factor appears to be very important in interpreting study data. When we look at the data from randomized studies and many large prospective studies done at experienced centers, we find a remarkable zero mortality rate for both open and laparoscopic operations. Conventional antireflux surgery has traditionally been known to have a mortality rate of 0.3–0.6%. Recent surveys report mortality rates of 0.008–0.2% for laparoscopic antireflux surgery and 0.2–0.8% for open surgery. These data underscore the importance of the learning curve for open operations and especially for the laparoscopic technique.

Experience in at least 50 operations is necessary in order to deal with small and moderate problems that arise during the procedure and avoid intraoperative injuries. These data have also been supported by other studies.
Finally, the importance of experience in laparoscopic surgery is confirmed by the problems that arose in one randomized study. So many cases of postoperative dysphagia occurred in the laparoscopic treatment arm that the study had to be terminated. The cause was the inadequate experience and low case numbers of the participating surgeons (fewer than three cases per surgeon per year). A detailed analysis of the data also reveals significant differences in the results of different randomized studies. Reports on morbidity range from 0% to 76%, recurrent reflux rate from 0% to 17%, and dysphagia from 0% to 58%. These discrepancies relate partly to the definition of the endpoints and their assessment, but they also result from differences in the experience of the participating surgeons with a particular technique. This would also explain the dramatic differences in dysphagia rates that have been reported by different authors (e.g., 4% versus 58%).

Experience with laparoscopic fundoplication is a very important criterion that has a major impact on morbidity and functional outcomes. The debate over the superiority of a partial or complete wrap is many decades old. For many years the partial wrap was thought to have relatively poor longevity, causing many surgeons to view it only as a compromise solution ("tailored approach") in patients with esophageal motility disorders. Currently available randomized studies have clearly shown that complete and partial fundoplication are equivalent in their long-term results. Hence, both techniques may be used concurrently and this is being done at many centers.

After the publication of these results, it was interesting to note that some surgeons decided to use only the laparoscopic Nissen fundoplication while others selected the Toupet technique as their standard procedure. Remarkably, the reoperation rate was found to be significantly lower after a partial fundoplication than after the Nissen fundoplication in a recently published detailed analysis. This raises the question of how experienced the surgeons were with a particular technique and whether differences in experience can influence the results.

Hardly any technical variant is as controversial, or debated as passionately, as the mobilization of the gastric fundus. Randomized studies cannot fully resolve this debate because the technique and extent of mobilization may vary greatly among different authors. Further studies are needed to clarify this issue.
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wrapping as a therapeutic principal in 
gastro-esophageal reflux prevention. 

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ment of esophageal reflux with hiatus hernia: 
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failed antireflux repairs. In: Esophageal disorders: 
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Instrument Set for Laparoscopic Fundoplication in the Treatment of Gastroesophageal Reflux Disease

Telescopes, Operating Instruments and Accessories
Recommended Set for Laparoscopic Gastric Surgery
(Laparoscopic Fundoplication, Gastric Banding etc.)

26003BA -hopkins® forward-oblique telescope 30°, enlarged view, diameter 10 mm, length 31 cm, autoclavable, fiber optic light transmission incorporated, color code: red

26003AE -endocam® hopkins® telescope, diameter 10 mm, length 32 cm, autoclavable, variable direction of view from 0° – 120°, adjustment knob for selecting the desired direction of view, fiber optic light transmission incorporated, color code: gold

30103MC 3 x trocar, with conical tip, with insufflation stopcock, size 11 cm, working length 10.5 cm, color code: green, including:
-cannula, without valve
-trocar only
-multifunctional valve

30160MC 2 x trocar, with conical tip, insufflation stopcock, size 6 mm, working length 10.5 cm, color code: black, including:
-cannula, without valve
-trocar only
-multifunctional valve

30140DB reduction sleeve, reusable, instrument diameter 5 mm, trocar cannula outer diameter 11 mm, color code: green

30141DB reducer, 11/5 mm

30623GB retreator for gastric banding, size 10 mm, length 36 cm

30623U cuschiери retreator, size 5 mm, length 36 cm

33333AF clickline® grasping forceps, rotating, dismantling, without connector pin for unipolar coagulation, with luer-lock irrigation connector for cleaning, double action jaws,atraumatic, fenestrated, size 5 mm, length 36 cm

33344MM clickline® moure disecting and grasping forceps, rotating, atraumatic, fenestrated, with slender, long and curved jaws, single action jaws, size 5 mm, length 36 cm

33344AB clickline® grasping forceps, rotating, atraumatic, distally toothed, round jaws, slender, delicate grasping, single action jaws, size 5 mm, length 36 cm

33533BLs clickline® babcock grasping forceps, rotating, dismantling, without connector pin for unipolar coagulation, with luer-lock irrigation connector for cleaning, double action jaws, rounded, long, size 10 mm, length 36 cm

32540PT surgical sponge holder, self-retaining, size 10 mm, length 30 cm

34351MW clickline® scissors, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with luer-lock irrigation connector for cleaning, double action jaws, serrated, curved, conical, size 5 mm, length 36 cm

34310MW clickline® scissors insert, for scissors, double action jaws, serrated, curved, conical, size 5 mm, length 36 cm

34361EK clickline® hook scissors, rotating, dismantling, without connector pin for unipolar coagulation, with luer-lock connector for cleaning, single action jaws, tips of jaws not crossing, size 5 mm, length 36 cm

37113A handle, pistol grip, with clamping valve, for suction and irrigation, autoclavable

301218-10 tubing set, with two puncture canulas, for single use, sterile, package of 10, for use with handles 30112 a (straight) and 37113 a (pistol grip) in combination with karl storz hamou® endomat® 26331009-1

301219-10 tubing set, with two puncture canulas, for single use, sterile, package of 10, for use with handles 37112 a (straight) and 37113 a (pistol grip) in combination with karl storz endomat® lc

37360LH suction and irrigation tube, with lateral holes, size 5 mm, length 36 cm, for use with suction and irrigation handles

30775UF coagulation and dissection electrode, L-shaped, with connector pin for unipolar coagulation, size 5 mm, length 36 cm

30775UFE exchangeable electrode tip, L-shaped, autoclavable, package of 6

26005M unipolar high frequency cord, with 5 mm plug, length 300 cm, for autocon® ii 400 SCB system (111, 113, 122, 125), autocon® II 200, autocon® II 80, karl storz autocon® system (50, 200, 350) and Erbe type ICC

26176LE bipolar high frequency cord, for autocon® II 400 SCB system (111, 113, 115, 122, 125), autocon® II 200, autocon® II 80, karl storz coagulator 26021 B/C/D, 860021 B/C/D, 27810 B/C/D, 28810 B/C/D, autocon® series (50, 200, 350), Erbe-Coagulator, T and ICC series, length 300 cm

38651CS RoBi® grasping forceps, clermont-Ferrand model, rotating, dismantling, with connector pin for bipolar coagulation, single action jaws, narrow jaws, for fine dissection, grasping and bipolar coagulation of fine structures, size 5 mm, length 36 cm

38651ON RoBi® grasping forceps, clermont-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, with fine atraumatic serration, fenestrated jaws, double action jaws, size 5 mm, length 36 cm

38651MD RoBi® KELLY grasping forceps, clermont-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, suitable for dissection, double action jaws, size 5 mm, length 36 cm

30173FAR Koh® macro needle holder, dismantling, with luer-lock irrigation connector for cleaning, single action jaws, straight jaws, with tungsten carbide inserts, with axial handle, disengagable ratchet, ratchet position right, size 5 mm, length 33 cm

26596SK kockering knot tier, for extracorporeal knotting, size 5 mm, length 36 cm

30444LR clip applicator, dismantling, rotating, size 10 mm, length 36 cm

30460AL Pilling-Weck titanium clip, medium-large, box with 16 sterile cartridges, 10 clips each
HOPKINS® Forward-Oblique Telescope 30°
diameter 10 mm, length 31 cm
diameter 5 mm, length 29 cm

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

EndoCAMeleon HOPKINS® Telescope

diameter 10 mm, length 32 cm,
autoclavable,
variable direction of view from 0° – 120°,
adjustment knob for selecting the desired direction of view,
fiber optic light transmission incorporated,
color code: gold
Trocars and Accessoires
size 6 and 11 mm

30103 MC  Trocar, with conical tip, with insufflation stopcock, size 11 cm, working length 10.5 cm, color code: green, including:
Cannula, without valve
Trocar only
Multifunctional Valve

30160 MC  Trocar, with conical tip, insufflation stopcock, size 6 mm, working length 10.5 cm, color code: black, including:
Cannula, without valve
Trocar only
Multifunctional Valve

30140 DB  Reduction Sleeve, reusable, instrument diameter 5 mm, trocar cannula outer diameter 11 mm, color code: green

30141 DB  Reducer, 11/5 mm
Scissors
CLICKLINE® – rotating, dismantling,
with and without connector pin for unipolar coagulation
size 5 mm, trocar size 6 mm

| Working Length | CLICKLINE® Scissors, double action jaws, serrated, curved, conical |
|----------------|-----------------------------------------------------------------
| 30 cm          | ![Image of scissors](image1.png)                               |
| 36 cm          | ![Image of scissors](image2.png)                               |
| 43 cm          | ![Image of scissors](image3.png)                               |

Single / Double-action jaws:

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</tbody>
</table>

**CLICKLINE® Hook Scissors, single action jaws, tips of jaws not crossing**

**CLICKLINE® Scissors** Inserts are available in attractively-priced sets of 12. Please add the letter “P” to the order number, e.g. 34310MWP.

Please note:
For CLICKLINE® instruments only the individual component parts are numbered. The catalog number for the complete instrument is not on the instrument. Instruments with insulated handles with connector pin for unipolar coagulation, are shown against the red background, instruments with handles without connector pin for unipolar coagulation are shown against the blue background. The colour green indicates the inserts.
Dissecting and Grasping Forceps

CLICKLINE® – rotating, dismantling, insulated, with connector pin for unipolar coagulation
size 5 mm, trocar size 6 mm

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<tr>
<td>33310ML</td>
<td>33351ML 33352ML 33353ML 33356ML</td>
</tr>
<tr>
<td>33410ML</td>
<td>33451ML 33452ML 33453ML 33456ML</td>
</tr>
</tbody>
</table>

Double-action jaws

- CLICKLINE® Dissecting and Grasping Forceps, long
- CLICKLINE® Grasping Forceps, atraumatic, fenestrated
- CLICKLINE® Dissecting and Grasping Forceps, atraumatic

Ein Maulteil beweglich:

- CLICKLINE® Grasping Forceps, with fine atraumatic serration, fenestrated

Please note:
For CLICKLINE® instruments only the individual component parts are numbered. The catalog number for the complete instrument is not on the instrument. Instruments with insulated handles with connector pin for unipolar coagulation, are shown against the red background. The colour green indicates the inserts.
Dissecting and Grasping Forceps
CLICKLINE® – rotating, dismantling, without connector pin for unipolar coagulation
size 5 mm, trocar size 6 mm

<table>
<thead>
<tr>
<th>Working Length</th>
<th>Handle 33161</th>
<th>Handle 33132</th>
<th>Handle 33133</th>
<th>Handle 33144</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36 cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43 cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Double-action jaws:

<table>
<thead>
<tr>
<th>Working Insert No.</th>
<th>Catalog number of the complete instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>33210AF</td>
<td>33261AF 33232AF 33233AF 33244AF</td>
</tr>
<tr>
<td>33310AF</td>
<td>33361AF 33332AF 33333AF 33344AF</td>
</tr>
<tr>
<td>33410AF</td>
<td>33461AF 33432AF 33433AF 33444AF</td>
</tr>
</tbody>
</table>

CLICKLINE® Grasping Forceps, atraumatic, fenestrated

<table>
<thead>
<tr>
<th>Working Length</th>
<th>Catalog number</th>
</tr>
</thead>
<tbody>
<tr>
<td>33310MM</td>
<td>33361MM 33332MM 33333MM 33344MM</td>
</tr>
</tbody>
</table>

CLICKLINE® MOURET Dissecting and Grasping Forceps, with slender curved jaws, large reservoir

Single-action jaws:

<table>
<thead>
<tr>
<th>Working Insert No.</th>
<th>Catalog number</th>
</tr>
</thead>
<tbody>
<tr>
<td>33310AB</td>
<td>33361AB 33332AB 33333AB 33344AB</td>
</tr>
</tbody>
</table>

CLICKLINE® MOURET Grasping Forceps, atraumatic, fenestrated, round jaws, slender

<table>
<thead>
<tr>
<th>Working Length</th>
<th>Catalog number</th>
</tr>
</thead>
<tbody>
<tr>
<td>33210ON</td>
<td>33261ON 33232ON 33233ON 33244ON</td>
</tr>
<tr>
<td>33310ON</td>
<td>33361ON 33332ON 33333ON 33344ON</td>
</tr>
<tr>
<td>33410ON</td>
<td>33461ON 33432ON 33433ON 33444ON</td>
</tr>
</tbody>
</table>

CLICKLINE® Grasping Forceps, with fine atraumatic serration, fenestrated

Please note:
For CLICKLINE® instruments only the individual component parts are numbered. The catalog number for the complete instrument is not on the instrument. Instruments with insulated handles with connector pin for unipolar coagulation, are shown against the red background. The colour green indicates the inserts.
Grasping Forceps

CLICKLINE® – rotating, dismantling, without connector pin for unipolar coagulation
size 10 mm, trocar size 11 mm

<table>
<thead>
<tr>
<th>Working Length</th>
<th>Handle 33161</th>
<th>Handle 33132</th>
<th>Handle 33133</th>
</tr>
</thead>
<tbody>
<tr>
<td>36 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Double-action jaws:

<table>
<thead>
<tr>
<th>Working Insert No.</th>
<th>Catalog number for the complete instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>33510BLS</td>
<td>33561BLS 33532BLS 33533BLS</td>
</tr>
</tbody>
</table>

CLICKLINE® BABCOCK Grasping Forceps, double action jaws, rounded

| 33510DU           | 33561DU 33532DU 33533DU                 |

CLICKLINE® DUVAL Grasping Forceps

Please note:

For CLICKLINE® instruments only the individual component parts are numbered. The catalog number for the complete instrument is not on the instrument. Instruments with handles without connector pin for unipolar coagulation are shown against the blue background. The colour green indicates the inserts.
RoBi® Bipolar Grasping Forceps

RoBi® – rotational, can be dismantle with connector pin for bipolar coagulation, CLERMONT-FERRAND Model, size 5 mm, trocar size 6 mm

<table>
<thead>
<tr>
<th>Outer Sheath</th>
<th>Handle</th>
</tr>
</thead>
<tbody>
<tr>
<td>36 cm</td>
<td>38151</td>
</tr>
<tr>
<td>43 cm</td>
<td></td>
</tr>
</tbody>
</table>

**Double-action jaws:**

<table>
<thead>
<tr>
<th>Working Insert No.</th>
<th>Catalog number for the complete instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>38610ON</td>
<td>38651ON</td>
</tr>
<tr>
<td>38710ON</td>
<td>38751ON</td>
</tr>
</tbody>
</table>

RoBi® Grasping Forceps, CLERMONT-FERRAND Model, fenestrated, with fine atraumatic serration, color code: light blue

<table>
<thead>
<tr>
<th>Single-action jaws:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>38610CS</td>
<td>38651CS</td>
</tr>
</tbody>
</table>

RoBi® Grasping Forceps, CLERMONT-FERRAND Model, for fine dissection, grasping and bipolar coagulation of fine structures, color code: light blue

Please note:

For RoBi® Bipolar Grasping Forceps instruments only the individual component parts are numbered. The catalog number for the complete instrument, as shown above against the red background is not on the instrument. The colour green indicates the inserts.
RoBi® Bipolar Scissors
RoBi® – rotational, can be dismantle with connector pin for bipolar coagulation, CLERMONT-FERRAND Model, size 5 mm, trocar size 6 mm

<table>
<thead>
<tr>
<th>Outer Sheath</th>
<th>Handle</th>
</tr>
</thead>
<tbody>
<tr>
<td>36 cm</td>
<td>38151</td>
</tr>
<tr>
<td>43 cm</td>
<td></td>
</tr>
</tbody>
</table>

### Single-action jaws:

<table>
<thead>
<tr>
<th>Working Insert No.</th>
<th>Catalog number for the complete instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>38610MT</td>
<td>38651MT</td>
</tr>
</tbody>
</table>

RoBi® Scissors, CLERMONT-FERRAND Model, action jaws straight, for cutting of vessels and tissue layers, color code: light blue

<table>
<thead>
<tr>
<th>Working Insert No.</th>
<th>Catalog number for the complete instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>38610MZ</td>
<td>38651MZ</td>
</tr>
</tbody>
</table>

RoBi® Scissors, CLERMONT-FERRAND Model, action jaws straight, serrated, color code: light blue

### Double-action jaws:

<table>
<thead>
<tr>
<th>Working Insert No.</th>
<th>Catalog number for the complete instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>38610MW</td>
<td>38651MW</td>
</tr>
<tr>
<td>38710MW</td>
<td>38751MW</td>
</tr>
</tbody>
</table>

RoBi® METZENBAUM Scissors, CLERMONT-FERRAND model, curved slender blades, double action jaws, color code: light blue

Please note:
For RoBi® Bipolar Grasping Forceps instruments only the **individual component parts** are numbered. The catalog number for the **complete instrument**, as shown above against the **red** background is not on the instrument. The colour **green** indicates the inserts.
Surgical Sponge Holder
Size 5 mm and 10 mm
Multiple puncture approach
Operating instruments, lengths 30 cm, for use with trocar size 6 and 11 mm

Special Features:
The instrument may be used as an atraumatic retractor and for blunt dissection.
The sponge can easily be replaced by push-button control.

32340PT Surgical Sponge Holder, self-retaining, size 5 mm, length 30 cm, including:
Handle
Outer Sheath, insulated
Sponge Holder Insert

32540PT Same, size 10 mm
Retractor for Gastric Banding
Size 5 and 10 mm
Operating instrument, length 36 cm,
for use with trocars size 6 and 11 mm

Special Features:

- Distal tip articulating up to 90°
- Blunt, atraumatic retractor element
- Fenestrated retractor element

The instrument is used as a blunt retractor in stomach and bowel surgery.
In gastric banding, the stomach band is anchored in the fenestration and pulled around the esophagus.

30623G Retractor for Gastric Banding,
size 5 mm, length 36 cm

30623GB Same, size 10 mm
CUSCHIERI Liver Retractor

Size 5 and 10 mm

Multiple puncture approach

Operating instrument, length 36 cm,
for use with trocars size 6 mm

30623U CUSCHIERI Retractor,
size 5 mm, length 36 cm

30623UR CUSCHIERI Retractor,
size 10 mm, length 36 cm

30623URL CUSCHIERI Retractor,
large contact surface, size 10 mm, length 36 cm
Handles for Suction and Irrigation

- **37112A Handle**, straight, with clamping valve, for suction and irrigation, *autoclavable*

- **37113A Handle**, pistol grip, with clamping valve, for suction and irrigation, *autoclavable*

Suction and Irrigation Tube, with lateral holes, size 5 mm, length 36 cm, for use with suction and irrigation handles

Dissecting Electrodes

- *with Exchangeable Electrode Tip*
- *Insulated Sheath with Connector Pin for Unipolar Coagulation*

Coagulation and Dissection Electrode, L-shaped, with connector pin for unipolar coagulation, size 5 mm, length 36 cm
- including:
  - **Outer Sheath**, insulated
  - **Plastic Handle**
  - **Electrode**, L-shaped
- **30775UFE Exchangeable Electrode Tip**, L-shaped, autoclavable, package of 6
**Tubing Sets**
for use with Handles 37112A and 37113A

031133-10* **Tubing Set**, for single use, sterile, package of 10, for use with Suction and Irrigation Handles 37112A and 37113A

031218-10* **Tubing Set**, with two puncture cannulas, for single use, sterile, package of 10, for use with Handles 37112A (straight) and 37113A (pistol grip) in combination with KARL STORZ HAMOU® ENDOMAT® 26331009-1

031219-10* **Tubing Set**, with two puncture cannulas, for single use, sterile, package of 10, for use with Handles 37112A (straight) and 37113A (pistol grip) in combination with KARL STORZ ENDOMAT® LC

031134-10* **Tubing Set**, for single use, sterile, package of 10, for use with Suction and Irrigation Handles 37112A and 37113A in combination with silicone tube inner diameter 5 mm at the patient end, for use with KARL STORZ HAMOU® ENDOMAT® 26331101-1 in combination with Tubing Set 031518-10

* mtp medical technical promotion gmbh, Take-Off GewerbePark 46, D-78579 Neuhausen ob Eck, Germany
KOH Macro Needle Holder

Cleaning and sterilization are gaining increasing importance for KARL STORZ as a manufacturer of surgical instruments. Similar to all our surgical instruments, the cleaning and hygiene of our needle holders also play an important role.

For cleaning and sterilization, the KOH macro needle holders can be disassembled into their main components.

This unique reusable three-piece design offers the user the following benefits:

- Can be disassembled into three separate components
- Autoclavable
- Cleaning adaptor
- Choice of six different handles and three different working inserts
- With tungsten carbide inserts
- In the event of damage, only the component with the defect needs to be replaced
Handles and Outer Tubes

KOH Macro Needle Holders, dismantable

Handles axial and pistol grip with disengageable ratchet

<table>
<thead>
<tr>
<th>Handle, axial, with disengageable ratchet, ratchet release on the right side</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173AR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Handle, axial, with disengageable ratchet, ratchet release on the left side</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173AL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Handle, axial, with disengageable ratchet, ratchet release on top</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173AO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Handle, pistol grip, with disengageable ratchet, ratchet release on the right side</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173PR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Handle, pistol grip, with disengageable ratchet, ratchet release on the left side</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173PL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Handle, pistol grip, with disengageable ratchet, ratchet release on top</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173PO</td>
</tr>
</tbody>
</table>

Metal Outer Sheath

Size 5 mm

<table>
<thead>
<tr>
<th>with Luer-Lock connector for cleaning</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173A</td>
<td>33 cm</td>
</tr>
<tr>
<td>30178A</td>
<td>43 cm</td>
</tr>
</tbody>
</table>
KOH **Macro Needle Holder**  
dismantable

**Size 5 mm**

<table>
<thead>
<tr>
<th>Working Length</th>
<th>Handle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30173AR</td>
</tr>
<tr>
<td>33 cm</td>
<td></td>
</tr>
<tr>
<td>43 cm</td>
<td></td>
</tr>
</tbody>
</table>

**Single-action jaws**

<table>
<thead>
<tr>
<th>Insert No.</th>
<th>Complete Instrument</th>
<th>Complete Instrument</th>
<th>Complete Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173R</td>
<td>30173RAR</td>
<td>30173RAL</td>
<td>30173RAO</td>
</tr>
<tr>
<td>30178R</td>
<td>30178RAR</td>
<td>30178RAL</td>
<td>30178RAO</td>
</tr>
</tbody>
</table>

KOH **Macro Needle Holder**, dismantling, jaws curved to right, with tungsten carbide inserts, for use with suture material size 0/0 – 7/0

<table>
<thead>
<tr>
<th>Insert No.</th>
<th>Complete Instrument</th>
<th>Complete Instrument</th>
<th>Complete Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173L</td>
<td>30173LAR</td>
<td>30173LAL</td>
<td>30173LAO</td>
</tr>
<tr>
<td>30178L</td>
<td>30178LAR</td>
<td>30178LAL</td>
<td>30178LAO</td>
</tr>
</tbody>
</table>

KOH **Macro Needle Holder**, dismantling, jaws curved to left, with tungsten carbide inserts, for use with suture material size 0/0 – 7/0

<table>
<thead>
<tr>
<th>Insert No.</th>
<th>Complete Instrument</th>
<th>Complete Instrument</th>
<th>Complete Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173F</td>
<td>30173FAR</td>
<td>30173FAL</td>
<td>30173FAO</td>
</tr>
<tr>
<td>30178F</td>
<td>30178FAR</td>
<td>30178FAL</td>
<td>30178FAO</td>
</tr>
</tbody>
</table>

KOH **Macro Needle Holder**, dismantling, straight jaws, with tungsten carbide inserts, for use with suture material size 0/0 – 7/0

<table>
<thead>
<tr>
<th>Insert No.</th>
<th>Complete Instrument</th>
<th>Complete Instrument</th>
<th>Complete Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173G</td>
<td>30173GAR</td>
<td>30173GAL</td>
<td>30173GAO</td>
</tr>
</tbody>
</table>

KOH **Macro Needle Holder**, dismantling, straight jaws
KOH **Macro Needle Holder**

dismantable

### Size 5 mm

<table>
<thead>
<tr>
<th>Working Length</th>
<th>Handle</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 cm</td>
<td>30173PR</td>
</tr>
<tr>
<td></td>
<td>30173PL</td>
</tr>
<tr>
<td></td>
<td>30173PO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Working Length</th>
<th>Handle</th>
</tr>
</thead>
<tbody>
<tr>
<td>43 cm</td>
<td>30173RPR</td>
</tr>
<tr>
<td></td>
<td>30173RPL</td>
</tr>
<tr>
<td></td>
<td>30173RPO</td>
</tr>
</tbody>
</table>

### Single-action jaws

<table>
<thead>
<tr>
<th>Insert No.</th>
<th>Complete Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173R</td>
<td>30173RPR</td>
</tr>
<tr>
<td>30173L</td>
<td>30173LPR</td>
</tr>
<tr>
<td>30178R</td>
<td>30178RPR</td>
</tr>
<tr>
<td>30178L</td>
<td>30178LPR</td>
</tr>
</tbody>
</table>

**KOH Macro Needle Holder,** dismantling, jaws curved to right, with tungsten carbide inserts, for use with suture material size 0/0 – 7/0

<table>
<thead>
<tr>
<th>Insert No.</th>
<th>Complete Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>30173F</td>
<td>30173FPR</td>
</tr>
<tr>
<td>30173G</td>
<td>30173GPR</td>
</tr>
</tbody>
</table>

**KOH Macro Needle Holder,** dismantling, straight jaws, with tungsten carbide inserts, for use with suture material size 0/0 – 7/0
**KOH Macro Needle Holder**

* size 5 mm  
* **Multiple puncture approach**  
* Operating instrument, **length 33 cm**, for use with trocars size 6 mm

<table>
<thead>
<tr>
<th>Working Length</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 cm</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>43 cm</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distal End</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>KOH Macro Needle Holder, with tungsten carbide insert, axial handle with disengageable ratchet, ratchet position right, jaws straight</td>
<td></td>
</tr>
<tr>
<td>26173KAF</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, axial handle with disengageable ratchet, ratchet position left, jaws curved to left</td>
</tr>
<tr>
<td>26178KAF</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, axial handle with disengageable ratchet, ratchet position right, jaws curved to right</td>
</tr>
<tr>
<td>26173KAL</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, axial handle with disengageable ratchet, ratchet position left, jaws curved to left</td>
</tr>
<tr>
<td>26178KAL</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, axial handle with disengageable ratchet, ratchet position right, jaws curved to right</td>
</tr>
<tr>
<td>26173KAR</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, axial handle with disengageable ratchet, ratchet position left, jaws curved to right</td>
</tr>
<tr>
<td>26178KAR</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, axial handle with disengageable ratchet, ratchet position right, jaws curved to right</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Working Length</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 cm</td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>43 cm</td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distal End</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>KOH Macro Needle Holder, with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position left, jaws straight</td>
<td></td>
</tr>
<tr>
<td>26173KPF</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position left, jaws curved to left</td>
</tr>
<tr>
<td>26178KPF</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position right, jaws curved to right</td>
</tr>
<tr>
<td>26173KPL</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position left, jaws curved to left</td>
</tr>
<tr>
<td>26178KPL</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position right, jaws curved to right</td>
</tr>
<tr>
<td>26173KPR</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position right, jaws curved to right</td>
</tr>
<tr>
<td>26178KPR</td>
<td>KOH Macro Needle Holder, with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position right, jaws curved to right</td>
</tr>
</tbody>
</table>
Knot Tier
Size 5 mm
Trocar size 6 mm

Clip Applicator
Size 10 mm
Multiple puncture approach
Operating instrument, length 33 cm,
for use with trocar size 11 mm

Caution:
The use of other clips than indicated, can lead to damage of the mouthpiece.
IMAGE1 S Camera System

**Economical and future-proof**
- Modular concept for flexible, rigid and 3D endoscopy as well as new technologies
- Forward and backward compatibility with video endoscopes and FULL HD camera heads
- Sustainable investment
- Compatible with all light sources

**Innovative Design**
- Dashboard: Complete overview with intuitive menu guidance
- Live menu: User-friendly and customizable
- Intelligent icons: Graphic representation changes when settings of connected devices or the entire system are adjusted
- Automatic light source control
- Side-by-side view: Parallel display of standard image and the Visualization mode
- Multiple source control: IMAGE1 S allows the simultaneous display, processing and documentation of image information from two connected image sources, e.g., for hybrid operations

**Dashboard**

**Live menu**

**Intelligent icons**

**Side-by-side view: Parallel display of standard image and Visualization mode**
**IMAGE1 S Camera System**

**FULL HD Imaging**
- Very high quality of endoscopic images in **FULL HD**
- Natural color rendition

- Multiple IMAGE1 S technologies for homogeneous illumination, contrast enhancement and color shifting

* SPECTRA A: Not for sale in the U.S.
** SPECTRA B: Not for sale in the U.S.
TC200EN*  
**IMAGE1 S CONNECT**, connect module, for use with up to 3 link modules, resolution 1920 x 1080 pixels, with integrated KARL STORZ-SCB and digital Image Processing Module, power supply 100–120 VAC/200–240 VAC, 50/60 Hz including:
- **Mains Cord**, length 300 cm
- **DVI-D Connecting Cable**, length 300 cm
- **SCB Connecting Cable**, length 100 cm
- **USB Flash Drive**, 32 GB, USB silicone keyboard, with touchpad, US

*Available in the following languages: DE, ES, FR, IT, PT, RU

For use with **IMAGE1 S**

**IMAGE1 S CONNECT Module TC200EN**

TC300  
**IMAGE1 S H3-LINK**, link module, for use with **IMAGE1 FULL HD** three-chip camera heads, power supply 100–120 VAC/200–240 VAC, 50/60 Hz, for use with **IMAGE1 S CONNECT TC200EN** including:
- **Mains Cord**, length 300 cm
- **Link Cable**, length 20 cm

For use with **IMAGE1 S**

**IMAGE1 S CONNECT Module TC200EN**

**TC300**  
**IMAGE1 S** FULL HD three-chip camera heads (fully compatible with **IMAGE1 S**)
- TH100, TH101, TH102, TH103, TH104, TH106
- 22220055-3, 22220056-3, 22220053-3, 22220060-3, 22220061-3, 22220054-3, 22220058-3

**LINK video outputs**
- 1x

**Power supply**  
- 100–120 VAC/200–240 VAC

**Power frequency**  
- 50/60 Hz

**Protection class**  
- I, CF-Defib

**Dimensions w x h x d**  
- 305 x 54 x 320 mm

**Weight**  
- 1.86 kg

* **SPECTRA A**: Not for sale in the U.S.
** **SPECTRA B**: Not for sale in the U.S.
IMAGE1 S Camera Heads

For use with IMAGE1 S Camera System

IMAGE1 S CONNECT Module TC200EN, IMAGE1 S H3-LINK Module TC300
and with all IMAGE1 HUB™ HD Camera Control Units

Specifications:

<table>
<thead>
<tr>
<th>IMAGE1 FULL HD Camera Heads</th>
<th>IMAGE1 S H3-Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>TH100</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x 1/3&quot; CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 100 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>270 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, f = 15–31 mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>

TH100

IMAGE1 S H3-Z Three-Chip FULL HD Camera Head, 50/60 Hz, IMAGE1 S compatible, progressive scan, soakable, gas- and plasma-sterilizable, with integrated Parfocal Zoom Lens, focal length f = 15–31 mm (2x), 2 freely programmable camera head buttons, for use with IMAGE1 S and IMAGE1 HUB™ HD/HD

Specifications:

<table>
<thead>
<tr>
<th>IMAGE1 FULL HD Camera Heads</th>
<th>IMAGE1 S H3-ZA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>TH104</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x 1/3&quot; CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 100 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>299 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, f = 15–31 mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>
Monitors

9619NB

19" HD Monitor,
color systems PAL/NTSC, max. screen resolution 1280 x 1024, image format 4:3,
power supply 100–240 VAC, 50/60 Hz,
wall-mounted with VESA 100 adaption,
including:
External 24 VDC Power Supply
Mains Cord

9826NB

26" FULL HD Monitor,
wall-mounted with VESA 100 adaption,
color systems PAL/NTSC,
max. screen resolution 1920 x 1080,
image format 16:9,
power supply 100–240 VAC, 50/60 Hz
including:
External 24 VDC Power Supply
Mains Cord
## Monitors

<table>
<thead>
<tr>
<th>KARL STORZ HD and FULL HD Monitors</th>
<th>19”</th>
<th>26”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall-mounted with VESA 100 adaption</td>
<td>9619NB</td>
<td>9826NB</td>
</tr>
</tbody>
</table>

**Inputs:**
- DVI-D
- Fibre Optic
- 3G-SDI
- RGBS (VGA)
- S-Video
- Composite/FBAS

**Outputs:**
- DVI-D
- S-Video
- Composite/FBAS
- RGBS (VGA)
- 3G-SDI

**Signal Format Display:**
- 4:3
- 5:4
- 16:9
- Picture-in-Picture
- PAL/NTSC compatible

### Optional accessories:
- **9826SF** Pedestal, for monitor 9826NB
- **9626SF** Pedestal, for monitor 9619NB

### Specifications:

<table>
<thead>
<tr>
<th>KARL STORZ HD and FULL HD Monitors</th>
<th>19”</th>
<th>26”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop with pedestal</td>
<td>optional</td>
<td>optional</td>
</tr>
<tr>
<td>Product no.</td>
<td>9619NB</td>
<td>9826NB</td>
</tr>
<tr>
<td>Brightness</td>
<td>200 cd/m² (typ)</td>
<td>500 cd/m² (typ)</td>
</tr>
<tr>
<td>Max. viewing angle</td>
<td>178° vertical</td>
<td>178° vertical</td>
</tr>
<tr>
<td>Pixel distance</td>
<td>0.29 mm</td>
<td>0.3 mm</td>
</tr>
<tr>
<td>Reaction time</td>
<td>5 ms</td>
<td>8 ms</td>
</tr>
<tr>
<td>Contrast ratio</td>
<td>700:1</td>
<td>1400:1</td>
</tr>
<tr>
<td>Mount</td>
<td>100 mm VESA</td>
<td>100 mm VESA</td>
</tr>
<tr>
<td>Weight</td>
<td>7.6 kg</td>
<td>7.7 kg</td>
</tr>
<tr>
<td>Rated power</td>
<td>28 W</td>
<td>72 W</td>
</tr>
<tr>
<td>Operating conditions</td>
<td>0–40°C</td>
<td>5–35°C</td>
</tr>
<tr>
<td>Storage</td>
<td>-20–60°C</td>
<td>-20–60°C</td>
</tr>
<tr>
<td>Rel. humidity</td>
<td>max. 85%</td>
<td>max. 85%</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>469.5 x 416 x 75.5 mm</td>
<td>643 x 396 x 87 mm</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–240 VAC</td>
<td>100–240 VAC</td>
</tr>
<tr>
<td>Certified to</td>
<td>EN 60601-1, protection class IPX0</td>
<td>EN 60601-1, UL 60601-1, MDD93/42/EEC, protection class IPX2</td>
</tr>
</tbody>
</table>
Accessories for Video Documentation

For use with telescopes, diameter 10 mm:
495 NCS   Fiber Optic Light Cable,
with straight connector,
extremely heat-resistant,
diameter 4.8 mm, length 250 cm

For use with telescopes, diameter 5 mm:
495 NA    Fiber Optic Light Cable,
diameter 3.5 mm, length 230 cm

Cold Light Fountain XENON 300 SCB

20133101-1 Cold Light Fountain XENON 300 SCB
with built-in antifog air-pump, and integrated
KARL STORZ Communication Bus System SCB
power supply: 100–125 VAC/220–240 VAC, 50/60 Hz
including:
Mains Cord
Silicone Tubing Set, autoclavable, length 250 cm
SCB Connecting Cable, length 100 cm

20133027  Spare Lamp Module XENON
with heat sink, 300 watt, 15 volt

20133028  XENON Spare Lamp, only,
300 watt, 15 volt

Cold Light Fountain Power LED 175 SCB

20161401-1 Cold Light Fountain Power LED 175 SCB,
with integrated SCB, high-performance LED
and one KARL STORZ light outlet,
power supply 110–240 VAC, 50/60 Hz
including:
Cold Light Fountain Power LED
Mains Cord
SCB Connecting Cable, length 100 cm

20132026  Xenon-Spare-Lamp, 175 Watt, 15 Volt
THERMOFLATOR® with KARL STORZ SCB
with High Flow Insufflation (30 l/min.)

26 4320 08-1 THERMOFLATOR® SCB
including:
THERMOFLATOR® with KARL STORZ SCB
power supply 100 – 240 VAC, 50/60 Hz
Mains Cord
OPTITHERM® Heating Element, sterilizable
Silicone Tubing Set, sterilizable
Universal Wrench
SCB Connecting Cable, length 100 cm
* CO₂/N₂O Gas Filter, sterile,
for single use, package of 10

Subject to the customer’s application-specific requirements additional accessories must be ordered separately.

ENDOFILATOR® 40 with KARL STORZ SCB
with High Flow Insufflation (40 l/min.)

UI400S1 ENDOFLATOR® 40 SCB,
Set, with integrated SCB module,
power supply 100 - 240 VAC, 50/60 Hz
including:
ENDOFILATOR® 40
Mains Cord, length 300 cm
SCB Connecting Cable, length 100 cm
Universal Wrench
Insufflation Tubing Set, with gas filter, sterile,
for single use, package of 5

Subject to the customer’s application-specific requirements additional accessories must be ordered separately.

HAMOU® ENDOMAT® with KARL STORZ SCB
Suction and Irrigation System

26331101-1 HAMOU® ENDOMAT® SCB,
power supply 100 – 240 VAC, 50/60 Hz
including:
Mains Cord
5x HYST Tubing Set*, for single use
5x LAP Tubing Set*, for single use
SCB Connecting Cable, length 100 cm
VACUsafe Promotion Pack Suction*, 2 l

Subject to the customer’s application-specific requirements additional accessories must be ordered separately.
Equipment Cart

**Equipment Cart**
wide, high, rides on 4 antistatic dual wheels
Equipped with locking brakes 3 shelves,
mains switch on top cover,
central beam with integrated electrical subdistributors
with 12 sockets, holder for power supplies,
potential earth connectors and cable winding
on the outside,

*Dimensions:*
- Equipment cart: 830 x 1474 x 730 mm (w x h x d),
- shelf: 630 x 510 mm (w x d),
- caster diameter: 150 mm

*Including:*
- **Base module equipment cart**, wide
- **Cover equipment**, equipment cart wide
- **Beam package equipment**, equipment cart high
- 3x **Shelf**, wide
- **Drawer unit with lock**, wide
- 2x **Equipment rail**, long
- **Camera holder**

**Monitor Swivel Arm,**
height and side adjustable,
can be turned to the left or the right side,
swivel range 180°, overhang 780 mm,
overhang from centre 1170 mm,
load capacity max. 15 kg,
with monitor fixation VESA 75/100,
for usage with equipment carts UGxxx
Recommended Accessories for Equipment Cart

**UG310**  
**Isolation Transformer,**  
200 V–240 V; 2000 VA with 3 special mains socket, expulsion fuses, 3 grounding plugs, dimensions: 330 x 90 x 495 mm (w x h x d), for usage with equipment carts UGxxx

**UG410**  
**Earth Leakage Monitor,**  
200 V–240 V, for mounting at equipment cart, control panel dimensions: 44 x 80 x 29 mm (w x h x d), for usage with isolation transformer UG310

**UG510**  
**Monitor Holding Arm,**  
height adjustable, inclinable, mountable on left or right, turning radius approx. 320°, overhang 530 mm, load capacity max. 15 kg, monitor fixation VESA 75/100, for usage with equipment carts UGxxx
Notes
WITH COMPLIMENTS OF
KARL STORZ—ENDOSKOPE