ENDOSCOPIC SURGERY OF ZENKER DIVERTICULUM

A Review of Current Techniques

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1.0 Historical Development

In 1769, LUDLOW published the earliest description of a mucosal pouch protruding through the posterior wall of the pharynx. ZENKER, in 1877, described five of his own cases and 22 cases drawn from other sources.

In 1908, KILLIAN described pulsion diverticula occurring at the junction of the hypopharynx and esophagus (Figs. 1, 2a, b). He identified the site of occurrence as a triangular area of relative muscular weakness located between the oblique and transverse fibers of the cricopharyngeus muscle.

WHEELER described the first surgical treatment of Zenker diverticulum in 1885. The operation consisted of a one-stage diverticulectomy performed through an external approach. Subsequent authors described a variety of external diverticulopexy and diverticulotomy techniques, which are outside our present scope. In 1917, MOSHER published the first report on an endoscopic diverticulotomy the endoscopic division of the common wall, or septum, between the diverticular pouch and esophageal lumen.

In 1932 SEIFERT recommended using a scissors for endoscopic diverticulotomy, and in 1943 DOHL-MAN recommended using an electrocautery.

After 1945, many surgeons in Germany stopped performing endoscopic diverticulotomy due to fears that it might cause potentially fatal bleeding from an abnormally placed right subclavian artery, inferior thyroid artery or other large vessel (LEGLER 1952). Surgeons also reported numerous instances of mediastinitis, poor functional results, and recurrences (HERR-MANN 1968, PAULSEN and KEIL 1970, DENECKE 1980, ESCHER 1984).

Outside of Germany, van OVERBEEK and HOEKSEMA (1982), van OVERBEEK et al. (1984), and HOLINGER and BENJAMIN (1987) recommended the use of specially designed rigid endoscopes with a distal notch that could be used to divide the septum with a laser beam delivered to the operative site through an operating microscope.

We have attempted to reestablish these operative methods in Germany as well.

With this in mind, we collaborated with the KARL STORZ company (Tuttlingen, Germany) to produce a modified version of our laryngoscope (WEERDA 1978, WEERDA and PEDERSEN 1981) with the blade length extended to 24 cm. Our goal was to minimize the risks by combining this new design with improvements in endoscopic operating technique (WEERDA, SCHLENTER et al. 1988, WEERDA et al. 1989).

When we first presented our reports at conferences in the late 1980s, they were met with skepticism and prompted an intense debate. Today, however, we note that endoscopic diverticulotomy by a variety of techniques has become an established surgical procedure (LAUBERT and LEHNHARDT 1989, PROBST et al. 1992, LIPPERT and WERNER 1995, ZBÄREN et al. 1999, N. WEERDA 2002 and 2003, MATTINGER and HÖRMANN 2002, SCHIPPER et al. 2006).

---

**Fig. 1**

Zenker diverticulum at the junction of the hypopharynx and posterior esophageal wall. The protrusion occurs in a relatively weak triangular area between the oblique and transverse fibers of the cricopharyngeus muscle. The pouch is located between the esophagus and spinal column, often shifted slightly toward the left side (after WEERDA 1994).
The advantages of endoscopic diverticulotomy over transcervical (external) diverticulectomy are documented in Tab. 1 (AHRENS 1993) and are summarized in Section 4 (see p. 14). MARTIN-HIRSCH and NEWBEGIN (1993) and COLLARD et al. (1993) described how a stapler developed for intestinal surgery could also be used to perform an endoscopic Zenker diverticulotomy by simultaneously dividing and stapling the diverticular septum. A modified form of this method was adopted at Freiburg University Hospital in 1994 (N. WEERDA et al. 2002 and 2003, SCHIPPER et al. 2006). In this booklet we will describe both methods, which are referred to as method I or the Lübeck method (p. 8) and method II or the Freiburg method (p. 16). We shall review the results of each method and evaluate them in our Conclusion. In the Summary, we will also consider how both methods might be effectively combined.

<table>
<thead>
<tr>
<th>Complications</th>
<th>External diverticulectomy with or without myotomy</th>
<th>Endoscopic diverticulotomy using various techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patients (n) Complications (%)</td>
<td>Patients (n) Complications (%)</td>
</tr>
<tr>
<td>Mortality</td>
<td>35/2270 1.5</td>
<td>7/991 0.7</td>
</tr>
<tr>
<td>Media stinitis</td>
<td>19/2188 0.9</td>
<td>15/988 1.5</td>
</tr>
<tr>
<td>Bleeding</td>
<td>– –</td>
<td>3/988 0.3</td>
</tr>
<tr>
<td>Fistulas</td>
<td>91/2147 4.2</td>
<td>– –</td>
</tr>
<tr>
<td>Permanent recurrent laryngeal nerve palsy</td>
<td>57/2235 2.5</td>
<td>2/973 0.2</td>
</tr>
<tr>
<td>Recurrence</td>
<td>168/1860 9.0</td>
<td>74/784 9.4</td>
</tr>
<tr>
<td>Wound healing problems</td>
<td>109/2810 3.9</td>
<td>– –</td>
</tr>
<tr>
<td>Other</td>
<td>64/2239 2.9</td>
<td>22/988 2.2</td>
</tr>
<tr>
<td>Stenosis</td>
<td>14/2239 0.6</td>
<td>12/973 1.2</td>
</tr>
<tr>
<td>Cutaneous emphysema</td>
<td>– –</td>
<td>22/988 2.2</td>
</tr>
</tbody>
</table>

Tab. 1
Complications associated with diverticulectomy (with or without myotomy) compared with endoscopic surgery. Review of the literature from 1945 to 1990 (from AHRENS 1993).

2.0 Symptoms and Diagnosis

Most older patients with a Zenker diverticulum complain of dysphagia ranging in severity from mild swallowing difficulty to a complete alimentary obstruction in the hypopharynx. Other complaints are the frequent regurgitation of undigested, often foul-smelling food residues and aspiration with occasional episodes of pneumonia. Patients experience weight loss and may become severely emaciated.

Radiographic examination after oral contrast administration (Figs. 2a, b) displays typical findings, especially in the lateral projection. BROMBART (1973) classified the radiographic findings into four stages based on the severity of the protrusion (Fig. 3, Tab. 2).
Each patient undergoes a thorough medical examination and endoscopy.

BROMBART (1973) classified Zenker diverticula into the following four stages based on the degree of protrusion in the lateral oral contrast radiograph (see Fig. 3):

**Fig. 3**
Classification of diverticula based on their appearance in the lateral radiograph after oral contrast administration (BROMBART 1973; see Tab. 2).

<table>
<thead>
<tr>
<th>BROMBART stages</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients (n = 68)</td>
<td>n = 0</td>
<td>n = 2</td>
<td>n = 27</td>
<td>n = 39</td>
</tr>
</tbody>
</table>

Tab. 2
Radiographic Brombart stages of Zenker diverticula in the Lübeck series (n = 68 patients). Stage I = small protrusion that disappears during swallowing. Stage II = diverticulum still visible when the esophagus is at rest. Stage III = saccular protrusion at least 10 mm long. Stage IV = large retroesophageal pouch that is constantly filled with contrast medium and is compressing the esophagus. Surgical treatment is indicated.

### 3.0 Surgical Treatment Methods

#### 3.1 Method I (Lübeck Method)

Microsurgical diverticulotomy with a CO₂ laser and the WEERDA distending diverticuloscope using sutures and glue for mediastinal closure.

The patient is placed under general anesthesia, preferably by nasal intubation, and the diverticular pouch is reinspected by endoscopy prior to the operation. The pouch is cleaned and flushed with antiseptic solution if necessary, and a gastric tube is placed under vision.

Next the WEERDA distending diverticuloscope (Fig. 4a, KARL STORZ 12067 A) is introduced, passing one blade into the diverticular pouch and the other into the esophagus. When the blades are in position, they are spread open so that the septum and fundus of the diverticulum can be clearly visualized (Figs. 5a, b; 8a).

The RIECKER-KLEINSASSER laryngoscope holder (KARL STORZ 8575 GK; Figs. 4b and 6b) is attached to the scope and is placed on the Lübeck-model chest support (Figs. 6a, b, KARL STORZ 8585 S). The chest support has a fine gear-and-thread mechanism for adjusting the height of the support plate and locking it in place. At that point the position of the diverticuloscope blades can be readjusted (Fig. 5b).
Fig. 4a  WEERDA distending diverticuloscope.

Fig. 4b  WEERDA distending diverticuloscope with the RIECKER-KLEINSASSER laryngoscope holder attached.

Fig. 5a  Intraoperative view of the septum after opening the blades of the diverticuloscope.

Fig. 5b  The septum of the Zenker diverticulum is stretched taut by the opened blades of the diverticuloscope. The fundus of the diverticulum is below (photograph taken with a HOPKINS 0° straight forward telescope, KARL STORZ).

Fig. 6a  Chest support, Lübeck model, with an adjustable, locking metal plate for supporting the laryngoscope holder and wire ring (suspension device for placing tongue blades, retractors, etc.). The thread mechanism and swivel arm can be precisely adjusted for the optimum positioning of various endoscopes (see Fig. 6b; KARL STORZ 8585 S) without exerting pressure on the patient's chest.

Fig. 6b  The diverticuloscope in place, suspended by the RIECKER-KLEINSASSER laryngoscope holder on the Lübeck model chest support (old model, see Fig. 6a). The patient is intubated transnasally and draped, and moist compresses are packed around the endoscope to prevent laser burns (see Fig. 14b).
In early endoscopic surgery, there were repeated reports of severe intraoperative bleeding (LEGLER 1952, MATTINGER and HöRMANN 2002), mediastinitis, and fistula formation (AHRENS 1993, KRESPI et al. 2002) that caused many surgeons to abandon this type of operation.

We felt that the easiest way to check the diverticular septum for atypical blood vessels would be to scan the septum with a small Doppler ultrasound probe (Fig. 7).

A special introducer rod with a distal probe clip has been developed for this application (Fig. 7, KARL STORZ 12067 U).

This prompted us to find ways to advance the endoscopic technique and minimize its risks.

**3.1.1 Risk Reduction**

Excluding blood vessels in the septum (see Fig. 7)

We felt that the easiest way to check the diverticular septum for blood vessels would be to scan the septum with a small Doppler ultrasound probe (Fig. 7).

A special introducer rod with a distal probe clip has been developed for this application (Fig. 7, KARL STORZ 12067 U).

Suturing and sealing the cut edges with fibrin glue

(Tissucol, Baxter, Heidelberg; see Figs. 12a, b and 14a, b).
3.1.2 Division of the Septum

The face should be completely covered during the laser surgery, and the towels or gauze compresses around the diverticulum should be moistened (Figs. 5a, 14b). Small, moist gauze strips are introduced with the WEERDA grasping forceps (KARL STORZ 12067 W, Fig. 9b) to protect the esophagus and diverticular mucosa from accidental laser burns (Figs. 8b, 9a; WEERDA 1993, WEERDA and SOMMER 2001).

The CO2 laser beam is delivered to the operative site through the microscope, and the septum is carefully and accurately divided down the center under optimum vision using noncontact laser technique (Fig. 9a; WEERDA et al. 1988, 1989, SOMMER et al. 2001).

If necessary, excess mucosa can be grasped with the small forceps (Fig. 9b) and resected with the laser. This is particularly common with large diverticula. The forceps has a built-in suction channel to maintain clear exposure of the operative site.

In the next step when the sutures are placed, the mucosa of the diverticular fundus can be pulled upward slightly to create a smoother junction with the rest of the esophagus (see Fig. 15b).
Placing the lateral sutures and sealing the mediastinum with glue

In 1994 we began suturing the wounds in the lateral wall to the fundus in addition to sealing the cut edges and mediastinum with glue. The wounds lines are sutured with 4-0 PDS (Ethicon, Norderstedt, Germany). To avoid tedious knot tying at long range, we place a small PDS vascular clip (KARL STORZ 12067 TT, Figs. 10a, b) on the end of the suture with the clip applicator (Figs. 10a, b, KARL STORZ 12067 TL, left, or TR, right) before the sutures are placed.

**Fig. 10a**
Extra-long, slender clip-applying forceps, designed by the authors for the intraluminal application of small PDS clips (Fig. 11a) (KARL STORZ 12067 TL and TR for left L and right R).

**Fig. 10b**
Jaws of the extra-long, slender forceps for applying PDS clips (shown here with a small vascular clip).

**Figs. 11a, b**
Extra-long needle holder (inset: KARL STORZ 12067 ML = angled to the left, 12067 MR = angled to the right) for endopharyngeal suturing, shown with a needle clamped in place and with a PDS vascular clip on the end of the suture instead of a knot (a) (4-0 PDS suture with a P3 needle, Ethicon, Norderstadt, Germany).
Next the continuous suture lines are placed using the extra-long needle holders angled 90° to the left or right (Fig. 11a, KARL STORZ 12067 ML [left] or MR [right]). Finally the running sutures are secured intra-luminally by placing a small PDS vascular clip (Fig. 10b) on the ends of each suture line with the clip-applying forceps (Fig. 10a); this eliminates the need for tedious knot tying. The PDS suture material and clips will be reabsorbed or expelled over time and are no longer visible after 6–8 weeks.

Sealing the Wounds and Mediastinum with Fibrin Glue

We also recommend sealing the wounds with fibrin glue (Tissucol, Baxter, Heidelberg) to secure the suture lines and mediastinum. Double tubing is cut to a length of approx. 32 cm and is connected to the hub of the double-barreled syringe, which contains the fibrin glue components (Fig. 14a). The distal end of the tubing is gripped with a small grasping forceps (Fig. 9b, KARL STORZ 12067 W) and passed through the diverticuloscope to the wound margins, where the fibrin glue is injected under microscopic control to reinforce the suture lines and seal the mediastinum (Fig. 14b).
3.1.3 Postoperative Care

**Gastric Tube**
If a gastric tube was not placed transnasally before the operation, it can now be passed down the esophagus and into the stomach under vision, directing it past the operative site. Some air is insufflated to confirm intragastric placement. Our patients are monitored overnight in the recovery room.

**Antibiotics**
We routinely give perioperative antibiotics for medicolegal reasons. The American literature does not describe the use of prophylactic antibiotics. SCHIPPER et al. (2006) give antibiotics only in patients with fever or suspected incipient mediastinitis.

**Postoperative Radiographs**
We obtain radiographs with aqueous oral contrast medium on the third or fourth postoperative day (first postoperative day in the Freiburg method), at which time the gastric tube is removed. A liquid diet is given initially, and the patient is discharged on the fifth or sixth postoperative day (SOMMER et al. 2001). This is also done in the Freiburg method (SCHIPPER et al. 2006; see Tab. 6).

A different protocol is followed in the U.S., where generally a gastric tube is not used. A liquid diet is prescribed for one week, and patients who are doing well are discharged home on the first or second postoperative day (Tab. 6). Based on the results in the U.S., it may be well to consider a shorter period of inpatient postoperative care in Germany as well (BRADWELL et al. 1997, SCHER and RICHTSMEIER 1998, COOK et al. 2000, PHILIPPSEN et al. 2000, SMITH et al. 2002).

**Endoscopic Follow-Up**
We schedule an endoscopic follow-up examination no earlier than 6–8 weeks after the operation.

### 3.1.4 Discussion of the Results

A total of 68 patients with a Zenker diverticulum were treated at Lübeck University Hospital from 1987 to 2001. Sixty-four of these patients underwent a transoral laser diverticulotomy, and the other four underwent transcervical surgery for various reasons (4/68 patients = 5.9%).

In 1994 we began suturing and gluing the lateral wounds and fundus using the technique described above (group II = 26 patients).

Residual septa were most commonly seen in radiographs of the 38 group I patients. Only three of the patients had functionally significant residual septa that required additional endoscopic surgery (see Tab. 3).

**Table 3**

<table>
<thead>
<tr>
<th>Subjective rating of outcomes</th>
<th>n = 64</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Satisfied</td>
<td>57</td>
<td>89.1</td>
</tr>
<tr>
<td>II Improved</td>
<td>6</td>
<td>9.4</td>
</tr>
<tr>
<td>III Dissatisfied</td>
<td>1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Three of the patients required a second diverticulotomy, and one required a third operation.

The average operating time was 30 minutes.
Two of four patients with relatively mild postoperative dysphagic complaints were found to have no residual septa. In the other eight patients, six reported no swallowing difficulties. It is noteworthy that oral contrast radiographs in almost all the patients showed a marked expansion of the esophagus at the operative site, which regressed significantly over a period of one year (Fig. 15b).

### 3.1.5 Complications

#### 3.1.5.1 Bleeding

Significant bleeding did not occur. We were able to exclude blood vessels larger than about 1 mm in diameter by scanning the septum with a Doppler probe (Fig. 7; Sonovit SV-1, Schiller, Baar, Switzerland). Smaller vessels were sealed by the laser during the diverticulotomy.

Small bleeders were occasionally encountered during division of the muscle and were controlled with a unipolar suction-cautery tip (KARL STORZ 12067 R or P, length 30 cm, or KARL STORZ 37270 SC).

### Postoperative radiographs

<table>
<thead>
<tr>
<th>Residual septum</th>
<th>n = 64</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14</td>
<td>22</td>
</tr>
</tbody>
</table>

**Tab. 4**
Evidence of a residual septum on postoperative radiographs taken on the third or fourth postoperative day.

**Fig. 15a**
Preoperative lateral radiograph of a large Zenker diverticulum filled with contrast medium.

**Fig. 15b**
Postoperative radiograph still shows an expansion at the level of the diverticular pouch, which generally disappears by about one year. The fundus of the pouch was pulled upward during suturing, resulting in a favorable angle at the esophageal junction (see p. 10).

### Complications of endoscopic diverticulotomy

<table>
<thead>
<tr>
<th></th>
<th>n = 64</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mediastinitis*</td>
<td>1</td>
<td>1.6</td>
</tr>
<tr>
<td>Fever</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspected mediastinal irritation</td>
<td>34</td>
<td>53.1</td>
</tr>
<tr>
<td>Transient, unilateral recurrent laryngeal nerve palsy</td>
<td>1</td>
<td>1.6</td>
</tr>
</tbody>
</table>

**Tab. 5**
Complications of endoscopic diverticulotomy (see also **Tab. 1**).

* Patient from group I.
3.1.5.2 Residual Septum and Recurrences (Tab. 3, 4)

It is unclear why diverticula occasionally recur shortly after the operation. This may result from a too tentative division of the diverticular septum, or it may involve a predisposition to diverticulum formation due to uncoordinated muscular action during swallowing. In our later group of 26 patients (group II), in which the septum was divided into the fundus and the mediastinum and cut edges were sutured and also sealed with glue, there were no instances of recurrence.

Radiographic evidence of a slight residual septum with no functional significance may be disregarded (SOMMER et al. 2001).

3.1.5.3 Mediastinitis (Tab. 5)

A mild postoperative temperature elevation (noted in 31 of 64 patients) may occur. In the early patient group whose wounds were not sutured and were closed only with glue, we observed one case of mediastinitis that responded well to an antibiotic combination.

One of 64 patients (68 operations) experienced transient recurrent laryngeal nerve palsy with hoarseness, which resolved in 6 weeks. Residual expansion of the esophagus seen on oral contrast radiographs (Fig. 15b) will generally regress over time. We will review the indications and disadvantages of endoscopic diverticulotomy after discussing the „Freiburg method.“

3.2 Method II (Freiburg Method)

Microsurgical diverticulotomy with a stapler (Endo GIA 30, Fig. 16a) using the WEERDA diverticuloscope.

In 1993, COLLARD et al. and MARTIN-HIRSCH and NEWBEGIN described their experience with a one-stage method for simultaneously dividing the diverticular septum and sealing the cut edges. They used a stapler developed for intestinal surgery (Endo GIA 30, Tyco Healthcare). This method was adopted at Freiburg University Hospital in 1994 and was later modified for use on Zenker diverticula (N. WEERDA et al. 2002, 2003, SCHIPPER et al. 2006).

Fig. 16a
MULTIFIRE ENDO GIA™ 30 stapler with interchangeable cartridges. Instrument length 31.5 cm, barrel diameter 1.2 cm, cartridge length 3.5 cm.

Fig. 16b
Close-up view of the staple cartridge (length 3.5 cm). Each half of the cartridge carries three staggered rows of staples, separated from the opposing half by a central knife blade. The original distal end is 1 cm long.
3.2.1 Method

This method is suitable only for diverticula larger than 2 cm (van EEDEN et al. 1999, COOK et al. 2001, SCHIPPER et al. 2006). Preparation and insertion of the diverticuloscope are the same as in method I (see p. 8) and should be preceded by the insertion of a nasogastric tube.

Endoscopic Inspection of the Septum

In the stapler developed for gastrointestinal surgery (Figs. 16a–c), the distal end of the staple cartridge forms a tapered projection approx. 1 cm long. The Freiburg surgeons have shortened the distal end to 5 mm so that it can be passed deeper into the diverticular pouch.

First the diverticulum is inspected with the HOPKINS 0° telescope (KARL STORZ 27005 AA) to exclude pulsating vessels in the septum. Then the opened stapler is passed over the septum, placing it as deep in the diverticulum as possible, and the blades of the stapler are closed.

Checking the Position of the Stapler Head (Fig. 17)

The accurate placement of the closed stapler head is checked with the 0° or 30° telescope (KARL STORZ 27005 AA and 27005 BA). The blades of the diverticuloscope should be opened as widely as possible at this time to facilitate stapler inspection (N. WEERDA et al. 2002, 2003, SCHIPPER et al. 2006).

Division of the Septum

The surgeon squeezes the trigger on the pistol grip (Fig. 16a) to activate the cutting and stapling mechanism. When fired, the stapler cuts through the septum and tightly seals the cut edges to the left and right of the myotomy, simultaneously sealing the blood vessels in the lateral edges. The stapler is removed, and the staple lines are microscopically inspected (Fig. 18).
Repeating the Diverticulotomy
If the stapler is not advanced far enough into the diverticulum or if the pouch is too large, a significant residual septum will remain. In this case the stapler cartilage is replaced with a new sterile cartilage, and the residual septum is divided and stapled.

Postoperative Surveillance
The patient spends approximately 24 hours in the recovery room. The blood count and temperature are monitored during this time.

Postoperative Radiographs
Oral contrast radiographs are taken on the first postoperative day in patients with an uneventful course. On the sixth day the nasogastric tube is removed and the patient is discharged home. Follow-up office visits should be scheduled at one week and again at one year. Antibiotics are contraindicated to avoid masking signs of incipient mediastinitis.

3.2.2 Results
The operating method was modified in 1998, and a total of 61 patients underwent the modified procedure from 1998 to 2003. The average patient age was 65.6 years (27–95 years).

In two patients (3.2%) the septum could not be visualized, and external surgery was performed. The septum was smaller than 2 cm in two patients and was divided with the CO₂ laser. The average duration of the operation was 17 minutes (Tab. 6).

Mediastinitis
Four patients were examined by thoracic radiography or CT to investigate rising inflammatory parameters. Two patients with suspected mediastinitis received a 7-day course of antibiotic therapy. One patient developed mediastinitis due a perforation, and this case had a fatal outcome (1.6%).

Recurrences
Ten patients (16.4%) experienced a recurrence of dysphagic symptoms and regurgitation within 12 months after the operation. The stapler myotomy was repeated in all ten of these patients, and there were no further instances of recurrence thereafter.

<table>
<thead>
<tr>
<th>Literature</th>
<th>Number of patients who underwent endoscopic stapler surgery</th>
<th>Duration of operation (%) (min.)</th>
<th>Hospital stay (days)</th>
<th>Time to initiation of liquid diet (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KOAY, BATES 1996</td>
<td>14</td>
<td>14.3</td>
<td>2.2</td>
<td>1</td>
</tr>
<tr>
<td>BALDWIN, TOMA 1998</td>
<td>(51)</td>
<td>–</td>
<td>–</td>
<td>1.5–3</td>
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<tr>
<td>SCHER, RICHTSMEIER 1998</td>
<td>36</td>
<td>40</td>
<td>1.3</td>
<td>0.5–1</td>
</tr>
<tr>
<td>OMOTE et al. 1999</td>
<td>21</td>
<td>22</td>
<td>4.7</td>
<td>1–2</td>
</tr>
<tr>
<td>NARNE et al. 1999</td>
<td>102</td>
<td>20</td>
<td>4.0</td>
<td>2</td>
</tr>
<tr>
<td>COOK et al. 2000</td>
<td>74</td>
<td>35</td>
<td>1.15</td>
<td>0.2–0.8</td>
</tr>
<tr>
<td>PHILIPPSEN et al. 2000</td>
<td>14</td>
<td>33</td>
<td>3.5</td>
<td>1</td>
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<tr>
<td>SMITH, URKEN 2002</td>
<td>8</td>
<td>25</td>
<td>1.3</td>
<td>0.8</td>
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<tr>
<td>Freiburger Kollektiv: SCHIPPER et al. 2006</td>
<td>61</td>
<td>17</td>
<td>6</td>
<td>1.2</td>
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<tr>
<td>Total or average</td>
<td>330</td>
<td>ca. 31</td>
<td>3.3</td>
<td>1–3</td>
</tr>
</tbody>
</table>

Tab. 6
Survey of the literature and the “Freiburg series” comparing the length of the operation, hospital stay, and time to initiation of a liquid diet (modified from SCHIPPER et al. 2006).
4.0 Summary and Discussion

The transcervical surgery of Zenker diverticulum is a time-consuming (90 min to 3 hours), traumatizing and stressful operation for most older patients. Surgery for a recurrent diverticulum is difficult due to scarring and the proximity of large vessels. The morbidity and mortality are higher than with endoscopic methods, as comparative studies and meta-analyses have shown (Tab. 1; WEERDA et al. 1989, WEERDA 1993, AHRENS 1993, van OVERBEEK 1994, NGUYEN and URQUHART 1997, BONAFEDE et al. 1997, ZBÄREN et al. 1999, SOMMER et al. 2001, SCHIPPER et al. 2006). Endoscopic surgery for recurrent diverticula is free of these problems (SCHER 2003).

4.1 Endoscopic Diverticulotomy

This operation was first described by MOSHER in 1917 and was introduced in Germany by SEIFERT in 1932. Endoscopic diverticulotomy was rejected during the 1950s due to limited visualization of the operative site and the potential for fatal complications. Outside of Germany, endoscopic laser diverticulotomy using broader, rigid endoscopes was reintroduced by van OVERBEEK in the Netherlands in 1984 and by HOLINGER and BENJAMIN in the U.S. in 1987. Van OVERBEEK (1994), ZBÄREN et al. (1999), and SCHER (2003) have noted the significant advantages of endoscopic surgery, which include lower morbidity, more rapid convalescence, shorter operating times, and shortened hospital stays (Tab. 6). Van OVERBEEK (1994) described the advantages of endoscopic diverticulotomy in a series of 545 patients, even without reinforced closure of the wound edges. By working with KARL STORZ to develop new instruments, especially the distending diverticuloscope, and by minimizing the surgical risk (WEERDA et al. 1988, 1989, 2001; SOMMER et al. 2001), we have attempted to restore endoscopic diverticulotomy as an established surgical option in Germany (Lübeck method I).

In 1993, COLLARD et al. and MARTIN-HIRSCH and NEWBEGIN described an elegant modification in which a stapler developed for intestinal surgery was used to simultaneously divide the diverticular septum and seal the cut edges (Fig. 16a). In 1994 this method was adopted and modified at the Freiburg center (N. WEERDA et al. 2002 and 2003, SCHIPPER et al. 2006), giving rise to the Freiburg method.

4.2 Comparison of Methods I and II (the Lübeck and Freiburg Methods)

Dividing the septum and simultaneously sealing the cut edges with a stapler (Freiburg method) is an elegant, appealingly simple and rapid procedure that takes approximately 17 minutes, compared with 30 minutes using the suture-and-glue technique (Lübeck method). The operating times reported in the literature (Tab. 6) range from 14 to 40 minutes, with an average duration of 31 minutes (Tab. 6). With large diverticula, the cartridge should be exchanged when the stapler method is used. The distal end of the standard cartridge is 1 cm long (Fig. 16c), causing the instrument to leave a significant residual septum. This may account for the relatively high recurrence rate of 16.4% in the Freiburg method. There have been occasional reports of perforations by the stapler tip (BRADWELL et al. 1997, HILTON and BRIGHTWELL 2000, COOK et al. 2000, MIRZA et al. 2002, N. WEERDA et al. 2002, 2003, SCHIPPER et al. 2006). The large, 12-mm diameter of the stapler barrel is a distinct disadvantage, making it difficult to visualize the septum and fundus. This may even be responsible for the occasional perforations that have occurred (Fig. 17).
4.3 Risk Reduction

The septum should be scanned with a Doppler probe (Fig. 7) when the stapling method is used. This provides a rapid and simple means of excluding large blood vessels, thereby minimizing the risk of intra- and postoperative bleeding. Cutaneous emphysema has a reported incidence of 2.2% in endoscopic surgery (Tab. 1), but this complication did not occur after any of the staple or suture closures in the Lübeck series.

4.4 Recurrences (Tab. 1)

Transcervical surgery is associated with a 9.0% recurrence rate, and the endoscopic techniques have an overall recurrence rate of 9.4%. Compared with these figures, the recurrence rate of 16.4% in the Freiburg method is remarkably high. MATTINGER and HÖRMANN (2002) described similarly high recurrence rates (8 of 52 patients = 15.4%) following diverticulotomies performed with a scissors or laser.

No recurrences occurred following the suture-and-glue closures in Lübeck group II (0 of 26 patients). In the Freiburg method, the 1-cm-long distal end of the staple cartilage (Figs. 16a–c) leaves a significant residual septum. It is also conceivable that the divided part of the septum may grow back together, especially in its lower portion.

Because the laser cut in the Lübeck method extends into the diverticular fundus and any excess mucosa is resected (SOMMER et al. 2001), suturing the wounds prevents the edges of the septum from growing back together (Figs. 12a, b). Also, the mediastinum is sealed under microscopic control. The fundus can be pulled upward when the sutures are placed, creating a favorable oblique junction with the rest of the esophagus (Fig. 15b).

In the Freiburg method, the distal end of the staple cartridge (Figs. 16a–c) should be substantially shortened in order to minimize the residual septum. If this is not possible, we suggest dividing the residual septum with a laser, scissors, or electrocautery and closing the cut edges with sutures and tissue adhesive (COOK et al. 2000, SOMMER et al. 2001).

4.5 Conclusion

If the diverticular septum can be visualized with the distending diverticuloscope, the method of choice is endoscopic diverticulotomy with the microscopically controlled CO₂ laser or stapler.


With a suitable oral diet, the gastric tube can be removed as early as the first or second postoperative day. The length of hospital stay ranges from 1 to 6 days in the literature (SMITH et al. 2004). The bleeding risk can be minimized by scanning the septum with a Doppler probe to check for relevant blood vessels before the septum is divided.

From a surgical standpoint and for medicolegal reasons, these methods that emphasize wound management are preferred over methods that involve simple division of the septum!
5.0 References


11. DOHLMAN G: Die Behandlung der Speiseröhren-Divertikel. Vortrag vor der schwedischen Arztesellschaft. Sektion Oto-Rhino-Laryngologie am 22.05.1941; Referat Zbl HNO 1943; 36: 466


21. LUDLOW, AA: A case of obstructed deglutition from a prenatural bag formed in the pharynx. In: Medical observations and inquiries by a society of physicians in London. 1769; 85–101; vol. 3, 2nd


40. VAN EEDEN S, LLOYD RV, TRANTER RM: Comparison of the endoscopic stapling technique with more established procedures for pharyngeal pouches: results and patient satisfaction survey. Department of Otolaryngology, Royal Sussex County Hospital, Brighton, UK. Laryngol Otol 1999; 113:237–40.


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WEERDA Distending Diverticuloscope for CO₂ Laser Technique

WEERDA Distending Diverticuloscope, length 24 cm, with adaption for suction tube 12067 M
Proximal size open: max. 40 x 27 mm
min. 29 x 27 mm
Distal size open: max. 65 x 18 mm
min. 7 x 18 mm

Fiber Optic Light Carrier, for distal illumination, working length 14 cm, for use with Laryngoscopes 8588 BV, 8590 A-JN, 8590 T, 8590 JV/TV and Diverticuloscopes 12067 A, 12068 A

Suction Tube, to remove vapor, for LASER treatment, outer diameter 3 mm

Laryngoscope Holder and Chest Support, GÖTTINGEN model, including:
Laryngoscope Holder, GÖTTINGEN model, with adjustment wheel
Support Rod, movable, with metal ring, diameter 9 cm, length 34 cm

or

BENJAMIN-PARSONS Laryngoscope Holder and Chest Support, including:
Laryngoscope Holder GOETTINGEN model, with adjustment wheel
BENJAMIN-PARSONS Support Rod, movable, with metal ring, diameter 12 cm and 2 lateral set screws, length 34 cm

It is recommended to check the suitability of the product for the intended procedure prior to use.
WEERDA Distending Diverticuloscope for Stapling Technique
for use with
HOPKINS® Straight Forward Telescope 10005 AA

WEERDA Distending Diverticuloscope,
length 24 cm, without adaptor for Suction Tube 12067 M
Proximal size open:    max.  40 x 27 mm
                      min.  29 x 27 mm
Distal size open:      max.  65 x 18 mm
                      min.  7 x 18 mm

HOPKINS® Straight Forward Telescope 0°,
enlarged view, diameter 4 mm, length 30 cm, autoclavable,
fiber optic light transmission incorporated,
color code: green

HOPKINS® Forward-Oblique Telescope 30°,
enlarged view, diameter 4 mm, length 30 cm, autoclavable,
fiber optic light transmission incorporated,
color code: red

Fiber Optic Light Carrier, for distal illumination, working length 14 cm,
for use with Laryngoscopes 8588 BV, 8590 A-JN, 8590 T, 8590 JV/TV and Diverticuloscopes 12067 A, 12068 A

Laryngoscope Holder and Chest Support, GÖTTINGEN model,
including:
Laryngoscope Holder, GÖTTINGEN model, with adjustment wheel
Support Rod, movable, with metal ring, diameter 9 cm, length 34 cm

BENJAMIN-PARSONS Laryngoscope Holder and Chest Support, including:
Laryngoscope Holder GOETTINGEN model, with adjustment wheel
BENJAMIN-PARSONS Support Rod, movable, with metal ring, diameter 12 cm and 2 lateral set screws, length 34 cm
LÜBECK Chest Support for Laryngoscope Holders

Special features:
- Moveable plate for chest supports 8575 K/KC, 8574 KT/KW
- Swivel holding arm
- Fine gear system complements height adjustment of chest support
- Ensures safe mounting of the chest support and the laryngoscope

- Ideal for children and overweight patients
- Support plate with lateral ring for attaching tongue spatula 743910 – 744405 for adenoidectomy and tonsillectomy

8585 S

8585 S Chest Support, LÜBECK model, with gear system for height adjustment and swivel arm with movable plate, for use with Laryngoscope Chest Supports 8575 K/KC, 8574 KT/KW, can be mounted on OR table equipped with standard sliding rail 25 x 10 mm
Instruments for Diverticuloscopy

12067 TL

Clip Forceps for Diverticuloscopy, applicator for absorbable ligating clips, jaw curved to left, with cleaning connector, working length 30 cm, for use with Clips 12067 TT

12067 TR

Same, jaw curved to right

12067 W

Grasping Forceps, alligator, with 1 x 2 teeth, double action jaws, sheath with suction channel to remove vapor, handle with ratchet to arrest jaw parts, working length 30 cm
Instruments for Diverticuloscopes

12067 ML/MR

12067 ML  FEHLAND Needle Holder, with ratchet, jaws size 3.0 mm x 5.8 mm, angled 90° to the left, working length 30 cm, sheath diameter 4.0 mm

12067 MR  Same, angled 90° to the right

12067 R

12067 S

12067 P  STEINER Insulated Cannula, for suction/coagulation, with ergonomic handle, fitting for unipolar coagulation, with cleaning stylet 12067 PM, working length 30 cm, outer diameter 3.5 mm

Please note:
Simultaneous use of insulated instruments and LASER is prohibited.
Instruments for Diverticuloscopes

Size 5 mm

**Multiple puncture approach**
Operating instruments, length 30 and 36 cm, for use with trocars size 6 mm

**Single puncture approach**
Operating instruments, length 43 cm, for use with operating laparoscopes with inbuilt working channel

<table>
<thead>
<tr>
<th>Distal Tip</th>
<th>Instrument No.</th>
<th>Description</th>
<th>Size</th>
<th>Length</th>
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<td>37270 SC</td>
<td>Coagulating and Dissecting Electrode, with suction channel</td>
<td>5 mm</td>
<td>30 cm</td>
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<td></td>
<td>37370 SC</td>
<td>Coagulating and Dissecting Electrode, with suction channel, blunt spatula</td>
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<td>30 cm</td>
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<td>37470 SC</td>
<td>Coagulating and Dissecting Electrode, with suction channel, L-shaped</td>
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<td>30 cm</td>
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<td>37270 DL</td>
<td>CUSCHIERI Dissecting Suction Tube, with suction channel</td>
<td>5 mm</td>
<td>36 cm</td>
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<td>37370 DL</td>
<td>Coagulating and Dissecting Electrode, with suction channel, U-shaped</td>
<td>5 mm</td>
<td>36 cm</td>
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<tr>
<td></td>
<td>37470 DL</td>
<td>MANGESHIKAR Coagulating and Dissecting Electrode, with irrigation channel, barrel-shaped</td>
<td>5 mm</td>
<td>36 cm</td>
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<tr>
<td></td>
<td>37270 DV</td>
<td>MANGESHIKAR Coagulating and Dissecting Electrode, with irrigation channel, ball end</td>
<td>5 mm</td>
<td>36 cm</td>
</tr>
</tbody>
</table>

**Handle with Trumpet Valve**, for suction or irrigation, autoclavable, for use with 5 mm coagulating suction tubes and 5 mm suction and irrigation tubes

**Please note:**
Simultaneous use of insulated instruments and LASER is prohibited.
**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

**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**
Brilliant Imaging
- Clear and razor-sharp endoscopic images in FULL HD
- Natural color rendition

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

FULL HD image

CLARA

FULL HD image

CHROMA

FULL HD image

SPECTRA A*

FULL HD image

SPECTRA A*

FULL HD image

SPECTRA B**

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

TC 200EN

TC 200EN* 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

** Specifications:**

<table>
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<tr>
<th>Feature</th>
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<td>HD video outputs</td>
<td>- 2x DVI-D</td>
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<td>- 1x 3G-SDI</td>
<td>1920 x 1080p</td>
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<tr>
<td>Format signal outputs</td>
<td>50/60 Hz</td>
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<tr>
<td>LINK video inputs</td>
<td>3x</td>
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<tr>
<td>USB interface</td>
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<td>SCB interface</td>
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<td>Power supply</td>
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For use with IMAGE1 S

** IMAGE1 S CONNECT Module TC 200EN**

TC 300

TC 300 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 TC 200EN including:

- **Mains Cord**, length 300 cm
- **Link Cable**, length 20 cm

** Specifications:**

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<td>Supported camera heads/video endoscopes</td>
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<td>2222059-3, 22220056-3, 22220053-3, 22220060-3, 22220061-3, 22220054-3, 22220085-3 (compatible without IMAGE1 S technologies CLARA, CHROMA, SPECTRA*)</td>
</tr>
<tr>
<td>LINK video outputs</td>
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<tr>
<td>Power supply</td>
<td>100–120 VAC/200–240 VAC</td>
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<td>Protection class</td>
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<td>1.86 kg</td>
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</table>

* SPECTRA A: Not for sale in the U.S.
** SPECTRA B: Not for sale in the U.S.
HD Imaging with Operating Microscopes
Direct Adaption

With the operating microscope the surgeon always has a perfect view of the operating field. Assistents, OR nurses and students, however, often experience poor video presentation, especially if FULL HD visualization is not available. KARL STORZ offers a one-stop-shop solution to upgrade any surgical microscope with state-of-the-art FULL HD imaging technology. To achieve optimal results, all components in the video chain – from the camera system to the monitor – must be of the highest quality.

The most straightforward and professional connection between camera and microscope is the so-called direct adaption.

Here the H3-M COVIEW microscope camera and the corresponding QUINTUS® TV adaptor are directly connected to the microscope via the C-MOUNT connection.

Direct adaption to the VARIO operating microscope from Carl Zeiss Meditec
IMAGE1 S Camera Heads

For use with IMAGE1 S Camera System
IMAGE1 S CONNECT Module TC 200EN, IMAGE1 S H3-LINK Module TC 300
and with all IMAGE1 HUB™ HD Camera Control Units

TH 106

TH 106  IMAGE1 S H3-M COVIEW Three-Chip FULL HD Camera Head, 50/60 Hz, IMAGE1 S compatible, progressive scan, with C-MOUNT thread for coupling to microscopes, 2 freely programmable camera head buttons, with detachable camera head cable, length 900 cm, for use with IMAGE1 S and IMAGE1 HUB™ HD/HD

200131

200131  Keypad, for H3-M camera head, for convenient control of the most important H3-M camera functions, with PS/2 connector, cable length 1 m, alternative to a standard keyboard, for use with H3-M or H3-M COVIEW camera heads, only compatible with IMAGE1 HUB™ HD, not compatible with IMAGE1 S

Specifications:

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HD Imaging with Operating Microscope
System Components

QUINTUS® – High-Performance TV Adaptor for Operating Microscopes

Unleash the full performance of your operating microscope from CARL ZEISS MEDITEC – with FULL HD imaging solutions from KARL STORZ.

The new QUINTUS® TV adaptor is the perfect interface between the operating microscope and the H3-M COVIEW FULL HD microscope camera head from KARL STORZ. The innovative features of QUINTUS® are easy to use, making it one of the most flexible TV adaptors on the market.

Product Features:

- A rotating C-MOUNT connection at the QUINTUS® TV adaptor allows immediate adaption of the camera orientation during mounting.
- The focus control makes it possible to easily achieve parfocality (perfectly sharp camera and microscope images).
- The iris control provides convenient and optimal adjustment of the depth of field.
- Pan (X) function enables adjustment of the horizontal position of the camera image.

- Tilt (Y) function enables adjustment of the vertical position of the camera image. The pan and tilt functions helps the surgeon to adjust the position of the camera image according to his individual needs.
- The QUINTUS® ZOOM model also features a variable focal length f = 43 – 86 mm. This allows the surgeon greater flexibility in choosing the exact zone required for documentation.

Focal length of the QUINTUS® TV adaptor:

The QUINTUS® TV adaptor is available in the fixed focal lengths f = 45 and f = 55 mm or as a zoom model with variable focal length 43 – 86 mm. This provides an optimal FULL HD image in 16:9 in conjunction with the H3-M COVIEW HD microscope camera head from KARL STORZ.
HD Imaging with Operating Microscope

System Components

**QUINTUS® TV Adaptor** for operating microscopes from CARL ZEISS MEDITEC with fixed focal length

- **QUINTUS® Z 45 TV Adaptor**, for CARL ZEISS MEDITEC operating microscopes, \( f = 45 \) mm, recommended for IMAGE 1 HD H3-M/H3-M COVIEW camera heads
- **QUINTUS® Z 55 TV Adaptor**, for CARL ZEISS MEDITEC operating microscopes, \( f = 55 \) mm, recommended for IMAGE 1 HD H3-M/H3-M COVIEW, H3, H3-Z as well as IMAGE 1 S1 and S3 camera heads

- **QUINTUS® Zoom TV Adaptor** for operating microscopes from CARL ZEISS MEDITEC with variable focal length

- **QUINTUS® Zoom TV Adaptor**, for CARL ZEISS MEDITEC operating microscopes, with variable focal length \( f = 43 - 86 \) mm, for use with all KARL STORZ cameras (SD and HD)

Further accessories for operating microscopes from CARL ZEISS MEDITEC

- **Iris**, for ZEISS Pentero®, iris as a necessary extension between the QUINTUS® TV adaptor and the operating microscope ZEISS Pentero®

- **Optical Beamsplitter 50/50**, for use with ZEISS operating microscope or colposcope

**Note:** Optical beamsplitters for other operating microscopes (i.e. LEICA or Möller-Wedel) are available directly from the manufacturers.
HD Imaging with Operating Microscope
System Components

QUINTUS® TV Adaptor for operating microscopes from LEICA Microsystems with fixed focal length

20 9330 45  QUINTUS® L 45 TV Adaptor, for LEICA Microsystems operating microscopes, f = 45 mm, recommended for H3-M microscope camera head

20 9330 55  QUINTUS® L 55 TV Adaptor, for LEICA Microsystems operating microscopes, f = 55 mm, recommended for IMAGE 1 HD H3-M/H3-M COVIEW, H3, H3-Z as well as S1 and S3 camera heads

QUINTUS® TV Adaptor for operating microscopes from LEICA Microsystems with variable focal length

20 9330 00 Z  QUINTUS® Zoom TV Adaptor, for LEICA Microsystems operating microscopes, with variable focal length f = 43 – 86 mm, for use with all KARL STORZ cameras (SD and HD)

QUINTUS® TV Adaptor for operating microscopes from Möller-Wedel with fixed focal length

20 9530 45  QUINTUS® M 45 TV Adaptor, for Möller-Wedel operating microscopes, f = 45 mm, recommended for IMAGE 1 HD H3-M/H3-M COVIEW camera heads

20 9530 55  QUINTUS® M 55 TV Adaptor, for Möller-Wedel operating microscopes, f = 55 mm, recommended for IMAGE 1 HD H3-M/H3-M COVIEW, H3, H3-Z and S1, S3 camera heads

Note: Optical beamsplitters for other operating microscopes (i.e. LEICA or Möller-Wedel) are available directly from the manufacturers.
**IMAGE1 S Camera Heads**

For use with IMAGE1 S Camera System
IMAGE1 S CONNECT Module TC 200EN, IMAGE1 S H3-LINK Module TC 300
and with all IMAGE1 HUB™ HD Camera Control Units

### TH 100

**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 \( f = 15–31 \text{ mm} \) (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-Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>TH 100</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 114 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 \text{ 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>

### TH 104

**IMAGE1 S H3-ZA Three-Chip FULL HD Camera Head**, 50/60 Hz, IMAGE1 S compatible, autoclavable, progressive scan, soakable, gas- and plasma-sterilizable, with integrated Parfocal Zoom Lens, focal length \( f = 15–31 \text{ mm} \) (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>TH 104</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>
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<tr>
<td>Weight</td>
<td>299 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, ( f = 15–31 \text{ 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

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9619 NB</td>
<td>19&quot; 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</td>
</tr>
<tr>
<td>9826 NB</td>
<td>26&quot; 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</td>
</tr>
</tbody>
</table>
### Monitors

**KARL STORZ HD and FULL HD Monitors**

<table>
<thead>
<tr>
<th>Wall-mounted with VESA 100 adaption</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>9619 NB</td>
<td>9826 NB</td>
</tr>
<tr>
<td>Inputs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DVI-D</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Fibre Optic</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>3G-SDI</td>
<td>–</td>
<td>●</td>
</tr>
<tr>
<td>RGBS (VGA)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>S-Video</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Composite/FBAS</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Outputs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DVI-D</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>S-Video</td>
<td>●</td>
<td>–</td>
</tr>
<tr>
<td>Composite/FBAS</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>RGBS (VGA)</td>
<td>●</td>
<td>–</td>
</tr>
<tr>
<td>3G-SDI</td>
<td>–</td>
<td>●</td>
</tr>
<tr>
<td>Signal Format Display:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4:3</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>5:4</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>16:9</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Picture-in-Picture</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>PAL/NTSC compatible</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

**Optional accessories:**

- 9826 SF **Pedestal**, for monitor 9826 NB
- 9626 SF **Pedestal**, for monitor 9619 NB

### Specifications:

**KARL STORZ HD and FULL HD Monitors**

<table>
<thead>
<tr>
<th>Desktop with pedestal</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>9619 NB</td>
<td>9826 NB</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>
Cold Light Fountains and Accessories

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>495 NL</td>
<td>Fiber Optic Light Cable, with straight connector, diameter 3.5 mm, length 180 cm</td>
</tr>
<tr>
<td>495 NA</td>
<td>Same, length 230 cm</td>
</tr>
</tbody>
</table>

Cold Light Fountain XENON 300 SCB

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20133027</td>
<td>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 SCB Connecting Cable, length 100 cm</td>
</tr>
<tr>
<td>20133101-1</td>
<td>Spare Lamp Module XENON with heat sink, 300 watt, 15 volt</td>
</tr>
<tr>
<td>20133028</td>
<td>XENON Spare Lamp, only, 300 watt, 15 volt</td>
</tr>
</tbody>
</table>

Cold Light Fountain XENON NOVA® 300

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20134001</td>
<td>Cold Light Fountain XENON NOVA®, 300, power supply: 100–125 VCA/220–240 VAC, 50/60 Hz including: Mains Cord</td>
</tr>
<tr>
<td>20133028</td>
<td>XENON Spare Lamp, only, 300 watt, 15 volt</td>
</tr>
</tbody>
</table>
Data Management and Documentation
KARL STORZ AIDA® – Exceptional documentation

The name AIDA stands for the comprehensive implementation of all documentation requirements arising in surgical procedures: A tailored solution that flexibly adapts to the needs of every specialty and thereby allows for the greatest degree of customization.

This customization is achieved in accordance with existing clinical standards to guarantee a reliable and safe solution. Proven functionalities merge with the latest trends and developments in medicine to create a fully new documentation experience – AIDA.

AIDA seamlessly integrates into existing infrastructures and exchanges data with other systems using common standard interfaces.

WD 200-XX*  AIDA Documentation System, for recording still images and videos, dual channel up to FULL HD, 2D/3D, power supply 100-240 VAC, 50/60 Hz including:
- USB Silicone Keyboard, with touchpad
- ACC Connecting Cable
- DVI Connecting Cable, length 200 cm
- HDMI-DVI Cable, length 200 cm
- Mains Cord, length 300 cm

WD 250-XX*  AIDA Documentation System, for recording still images and videos, dual channel up to FULL HD, 2D/3D, including SMARTSCREEN® (touch screen), power supply 100-240 VAC, 50/60 Hz including:
- USB Silicone Keyboard, with touchpad
- ACC Connecting Cable
- DVI Connecting Cable, length 200 cm
- HDMI-DVI Cable, length 200 cm
- Mains Cord, length 300 cm

*XX Please indicate the relevant country code (DE, EN, ES, FR, IT, PT, RU) when placing your order.
Workflow-oriented use

**Patient**
Entering patient data has never been this easy. AIDA seamlessly integrates into the existing infrastructure such as HIS and PACS. Data can be entered manually or via a DICOM worklist. All important patient information is just a click away.

**Checklist**
Central administration and documentation of time-out. The checklist simplifies the documentation of all critical steps in accordance with clinical standards. All checklists can be adapted to individual needs for sustainably increasing patient safety.

**Record**
High-quality documentation, with still images and videos being recorded in FULL HD and 3D. The Dual Capture function allows for the parallel (synchronous or independent) recording of two sources. All recorded media can be marked for further processing with just one click.

**Edit**
With the Edit module, simple adjustments to recorded still images and videos can be very rapidly completed. Recordings can be quickly optimized and then directly placed in the report. In addition, freeze frames can be cut out of videos and edited and saved. Existing markings from the Record module can be used for quick selection.

**Complete**
Completing a procedure has never been easier. AIDA offers a large selection of storage locations. The data exported to each storage location can be defined. The Intelligent Export Manager (IEM) then carries out the export in the background. To prevent data loss, the system keeps the data until they have been successfully exported.

**Reference**
All important patient information is always available and easy to access. Completed procedures including all information, still images, videos, and the checklist report can be easily retrieved from the Reference module.
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 5/100,
for usage with equipment carts UG xxx
Recommended Accessories for Equipment Cart

**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 UG xxx

**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 UG 310

**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 UG xxx
Notes:
WITH COMPLIMENTS OF
KARL STORZ — ENDOSKOPE