NEUROENDOSCOPIC
COLLOID CYST RESECTION

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1.1 Colloid Cysts

Colloid cysts of the third ventricle are rare intracranial tumors thought to arise from the roof of the anterior third ventricle\(^1\)\(^-\)\(^2\). They are comprised of mucin-producing ciliated epithelial cells and their contents\(^3\)\(^-\)\(^4\). Symptomatic patients most commonly present with headache, that can be intermittent and positional in nature\(^5\). Patients can have various other symptoms that include memory deficits, tinnitus, syncope, gait changes, nausea, vomiting, seizures, or visual disturbances\(^6\)\(^-\)\(^8\). Colloid cysts are almost always located in the anterior and superior portion of the third ventricle adjacent to the foramen of Monro. Unilateral or bilateral obstruction of the foramen of Monro by the colloid cyst can result in obstruction of CSF flow that may result in enlargement of one or both lateral ventricles and obstructive hydrocephalus. Symptomatic patients with colloid cysts can develop acute neurologic deterioration. Cases of sudden death have been attributed to colloid cysts and may be the result of acute obstructive hydrocephalus\(^7\)\(^-\)\(^11\). Patients do not have to have ventricular enlargement or obstructive hydrocephalus to be symptomatic from their colloid cyst \(^12\)\(^,\)\(^13\).

1.2 Obstructive Hydrocephalus

Symptomatic colloid cyst patients with or without hydrocephalus are in general recommended for surgery. Complete surgical excision of the colloid cyst capsule and contents is curative and is the treatment of choice for patients. The option of observation of colloid cysts in symptomatic patients becomes risky as acute neurologic decline and sudden death have been reported\(^7\)\(^,\)\(^11\)\(^,\)\(^14\). In a study from the Netherlands, the risk of acute deterioration in a symptomatic patient with a colloid cyst was estimated to be 34%\(^7\). In patients who are asymptomatic, colloid cysts can be cared for safely with observation and serial neuroimaging\(^15\)\(^,\)\(^16\). The incidences of patient symptomatic progression related to the colloid cyst are 0%, 0%, and 8% at 2, 5, and 10 years respectively.

1.3 Endoscopic Resection of Colloid Cysts

The goal of colloid cyst resection is complete excision and restoration of cerebrospinal fluid (CSF) flow. The risks and complications associated with colloid cyst resection are mainly due to the intimate association of colloid cysts at the foramen of Monro with important deep venous tributaries, the fornices, and the hypothalamus. Pure endoscopic treatment of colloid cysts due to their midline and intraventricular location has become a standard of care that is minimally invasive\(^17\)\(^-\)\(^30\). Endoscopic resection of third ventricle colloid cysts was first reported in 1982\(^31\). Multiple series of pure endoscopic resection of colloid cysts have now been published by various centers around the world\(^17\)\(^,\)\(^19\),\(^26\),\(^32\). Advantages of endoscopic treatment include smaller incisions, use of a burr hole instead of a craniotomy, no brain retraction, shorter operative times, and potentially shorter hospital admissions. Comparison studies between craniotomy and microsurgical approaches and endoscopic resection of colloid cysts, however, have revealed a lower rate of complete cyst excision and a higher rate of cyst recurrence in patients who undergo endoscopic resection of their colloid cyst\(^33\)\(^-\)\(^36\).

Difficulty dissecting and removing the colloid cyst capsule from the thalamostriate and septal venous tributaries as well as controlling intraoperative hemorrhage during cyst resection can result in incomplete resection of colloid cysts. Conversion to a craniotomy due to inability to resect the colloid cyst endoscopically has been reported\(^22\),\(^24\). Complications associated with endoscopic removal of colloid cysts are similar to craniotomy and microsurgical approaches and include septic or aseptic meningitis, intraventricular hemorrhage, and temporary worsening of short term memory\(^24\),\(^28\). Recent case series of endoscopic colloid cyst resection however have now shown high complete resection rates, good outcomes, low complication rates, and recurrence rates as low as zero\(^17\),\(^26\),\(^29\).

In this monograph, a detailed description of the neuroendoscopic resection of colloid cysts will be discussed utilizing the LOTTA\(^\text{®}\) 30°, developed by Professor Henry W. S. Schroeder (Greifswald, Germany). The neuroendoscopic technique discussed will provide the technique for the neurosurgeon to achieve a complete resection of the colloid cyst in a minimally invasive and safe manner. As with any surgical approach, complications may occur. However, a thorough understanding of the neuroendoscopic technique described, including methods to avoid injury to surrounding vital structures, may result in routine complete resection of colloid cysts safely.
2.1 Why a 30-Degree Endoscope?

The LOTTA® 30° neuroendoscope permits the neurosurgeon to have an optimal view of the foramen of Monro and the colloid cyst in the third ventricle (Fig. 1). Proper visualization with any endoscopic procedure is the key to the success of the procedure. The 30-degree angle to the light emitted from the tip of the endoscope allows the neurosurgeon to visualize the base of the colloid cyst in addition to the roof of the third ventricle where the colloid cyst is felt to originate. This permits better access to the foramen of Monro for cautery, dissection, and removal of the colloid cyst. The LOTTA® 30° rigid rod-lens scope is permanently incorporated into the working channel system and does not have to be inserted (Fig. 2a). This minimizes the potential for damage to the rigid rod-lens by manipulation. The tip of the angled endoscope has been designed to minimize any trauma to the ependymal surface of the lateral ventricle and provides a high definition display with optimal lighting (Fig. 2b). Furthermore, with the LOTTA® 30°, better visualization of the tips of instruments inserted through each working channel is possible.

2.2 Specifications

The outer diameter of the LOTTA® 30° is 6.1 mm. The overall length of the working channel endoscope is 18 cm. There are 3 working channels available for use during a neuroendoscopic procedure. The central channel is the largest measuring 2.9 mm in diameter. The central working channel is mainly used during the neuroendoscopic colloid cyst resection for bipolar cautery and use of the single action biopsy forceps. Each of the side working channels are 1.6 mm in diameter. They can be used for continuous irrigation as well as intermittent suction during the procedure. Smaller blunt cup forceps can be used through the side channels. Bimanual dissection is possible with use of multiple working channels simultaneously. However, as described below, bimanual dissection is not required for the neuroendoscopic resection of colloid cysts.
2.3 Irrigation and Use of Suction

Confirmation of proper functioning of the LOTTA® 30 with the light source, high definition camera, and visualization on the high definition monitors is crucial to the success of the neuroendoscopic procedure. As mentioned, one of the side working channels is used for continuous irrigation with normal saline solution. Gravity flow is all that is required for the continuous irrigation. A foot pedal control for irrigation is not required. Intermittent suction through one of the side working channels can be performed by placement of the tip of a handheld suction device on the working channel opening. Care is taken to briefly apply the handheld suction to the working channel opening to avoid inadvertent suction of the choroid plexus and potential bleeding. Continuous suction through the working channel is not needed and not recommended.

2.4 Endoscopic Instruments

The main instruments utilized for neuroendoscopic resection of colloid cysts through the LOTTA® 30° include the bipolar cautery device (Fig. 2c), blunt single action biopsy forceps (Fig. 2d), and sharp scissors. The 1.7 mm bipolar cautery device (30 cm in length) is crucial to the success of the colloid cyst resection to properly shrink the colloid cyst and cauterize vessels leading to the colloid cyst capsule that will hemorrhage if not thermally coagulated. The bipolar cautery device is also important for hemostasis after resection and placement of the septum pellucidum fenestration. The 2.7 mm single action biopsy forceps (30 cm in length) allows proper grasping of the colloid cyst capsule and contents for complete removal of the colloid cyst. Endoscopic sharp scissors are occasionally required to dissect the colloid cyst away from the fornical bundle, septal vein, or thalamostriate vein.
**3.1 Patient / Surgeon Positioning and Placement of High Definition Monitors**

An anterolateral neuroendoscopic technique is performed for the approach to the colloid cyst at the foramen of Monro. After patients undergo general endotracheal anesthesia, they are maintained supine on an operating room table turned to the right side of the room for all right-sided approaches (Figs. 3). Rarely, if the colloid cyst is to the left of midline or unilateral obstruction of the left lateral ventricle is present, a left-sided approach performed. The patient’s head is immobilized in a 3-pin modified head holder and placed in a neutral position. Slight elevation of the head of the patient is helpful. Once the head is positioned, the patient undergoes neuronavigation registration. The neuronavigation unit can be placed at the head or foot of the operating room table. The high definition monitors and tower used for the neuroendoscopic procedure are placed to the left of the patient as the surgeon and surgical assistant stand to the right of the patient’s head and have direct line of sight to the monitors for the entire procedure (Fig. 3a).

**3.2 Neuronavigation / Incision and Burr Hole**

The incision is 2 cm in length and marked at a point 8 cm posterior to the nasion and 5–7 cm lateral to midline (Figs. 3b, c). A trajectory is chosen with neuronavigation that permits access to the frontal horn of the lateral ventricle while avoiding the caudate nucleus. A small amount of hair is clipped behind the incision for exit of the external ventricular drainage catheter placed at the completion of the procedure. The incision is prepped and draped in a sterile fashion.
The primary neurosurgeon with one surgical assistant and one surgical technician are needed for the neuroendoscopic procedure (Fig. 4a). For the right-sided approach, the surgical assistant stands behind the patient’s head, just to right of midline. The primary neurosurgeon stands to the right of the assistant and is able to navigate the working channel neuroendoscope (Fig. 4b).

After the incision is made and bovie cautery dissection is performed to the frontal bone, a small skin retractor is used. Next, a burr hole approximately 7 mm in diameter is placed in the frontal bone using a high-speed drill (Fig. 5a). Once the burr hole is completed, opening of the dural leaflets is performed in a cruciate fashion with a number 11 scalpel or bovie cautery.

### 3.3 Cannulation of Lateral Ventricle

Cannulation of the lateral ventricle through the burr hole is achieved with the operating sheath of the LOTTA® 30° with the blunt obturator inserted or a peel-away sheath trocar introducer. The LOTTA® 30° operating sheath with obturator or trocar introducer is advanced orthogonal to the skull, utilizing neuronavigation and targeting the frontal horn of the ipsilateral lateral ventricle (Fig. 5b). Neuronavigation tracking of the tip of the obturator trocar is used to enter the frontal horn of the lateral ventricle and avoid the caudate nucleus. Cannulation of the lateral ventricle with the LOTTA® 30° is performed by direct endoscopic visualization with the high definition monitor and use of the neuronavigation system. If a trocar introducer is used, it is inserted to a depth of 5–6 cm and confirmation of cerebrospinal fluid (CSF) flow is performed after the trocar is removed. The sheath is peeled down and secured to the scalp using staples. The LOTTA® 30° is then inserted through the sheath into the lateral ventricle.
3.4 Intraventricular Anatomy (Lateral and Third Ventricles)

After introduction of the LOTTA® 30° into the lateral ventricle, visualization of intraventricular anatomic landmarks is performed (Fig. 6a). The choroid plexus is initially visualized and followed anteriorly to the foramen of Monro. The septal vein is visualized medially coursing superiorly within the septum pellucidum. The thalamostriate vein is visualized posterior to the foramen of Monro coursing laterally between the caudate and thalamus. At this point, the greenish colored colloid cyst capsule is visualized in the third ventricle through the foramen of Monro beneath the choroid plexus (Fig. 6b). If the patient has evidence of ventriculomegaly and obstructive hydrocephalus, the colloid cyst can enlarge the foramen of Monro and stretch the fornixal bundle.

Endoscopic visualization of the foramen of Monro by a right anterolateral approach. The choroid plexus is visualized at the foramen of Monro. The septal vein courses medially while the thalamostriate vein courses laterally (a). The greenish-colored colloid cyst is visualized obstructing the foramen of Monro (b).

4 Neuroendoscopic Colloid Cyst Resection Through the Working Channel

4.1 Bipolar Cautery of Choroid Plexus

Through the working channel, endoscopic bipolar cautery of the choroid plexus overlying the foramen and colloid cyst is performed. Cautery allows for retraction of the choroid plexus away from the foramen and better visualization of the colloid cyst. Rarely, the septal vein may course over the capsule of the colloid cyst and require cautery.

4.2 Bipolar Cautery of Colloid Cyst Capsule

Endoscopic bipolar cautery is judiciously used to cauterize the colloid cyst capsule and reduce the diameter of the colloid cyst (Figs. 7a, b). Use of the endoscopic bipolar cautery may be the most important step in the neuroendoscopic resection of colloid cysts and needs to be performed well to minimize complications associated with colloid cyst removal. Cautery permits dissection of the colloid cyst away from the fornix and the septal and thalamostriate venous complex (Fig. 7c). Care is taken not to apply any thermal injury to the fornix as well as to the venous complex. Cautery of colloid cyst base and the small blood vessels supplying the colloid cyst capsule are important to avoid hemorrhage during removal of the cyst. In essence, the use of bipolar cautery can permit the cautery of the superior, ipsilateral side, and base of the colloid cyst in the third ventricle (Fig. 7d).
Neuroendoscopic colloid cyst resection through the LOTTA® 30°. Partial cautery of the choroid plexus and colloid cyst capsule (b). Use of the bipolar cautery device to dissect away from the fornix and septal/thalamostriate venous complex (c). After thorough bipolar cautery and cyst decompression, the colloid cyst has been markedly reduced in size (d).

4.3 Puncturing of Colloid Cyst Capsule and Decompression of Cyst

After thorough cauterization of the colloid cyst capsule and surrounding choroid plexus, an en block removal of the colloid cyst can be performed with smaller colloid cysts. With larger colloid cysts (≥ 1 cm), puncturing of the colloid cyst capsule is performed with the endoscopic bipolar tip to reduce the volume of the colloid cyst and lessen any further traction on the fornix. Decompression of the colloid cyst contents occurs once the colloid cyst capsule is fenestrated. Intermittent suction of the colloid cyst contents through a working channel avoids spillage into the lateral ventricle. Further cautery at this point permits even more shrinkage of the colloid cyst capsule and allows for definitive dissection of the colloid cyst capsule off the fornix, the roof of the third ventricle, and the deep venous structures (Fig. 7d). Sharp dissection can also be performed if needed with endoscopic scissors to further separate the colloid cyst from surrounding structures.

4.4 Complete Neuroendoscopic Removal of Colloid Cyst Capsule and Contents

The single action biopsy forceps is used to grab the colloid cyst capsule including its residual cyst contents (Fig. 8a). Slow, gentle traction is performed to allow for complete removal of the entire colloid cyst en block in the majority of cases (Fig. 8b). En block resection of the entire colloid cyst is performed while grasping the capsule and colloid cyst contents with the single action biopsy forceps and removing the entire LOTTA® 30° scope since the working channel portal is too small in diameter (less than 3 mm) to pull the colloid cyst through. In certain circumstances with larger colloid cysts, a piecemeal resection can be performed to decrease the volume of the cyst prior to an en block resection of the residual capsule and contents.
Neuroendoscopic en block removal of the colloid cyst. Use of the blunt endoscopic cup forceps to grasp the colloid cyst capsule and contents for removal (a). Complete en block removal of the colloid cyst (b).

4.5 Inspection of Third Ventricle

Copious irrigation of the ventricles (>2 liters) is performed transcortically after removal of the colloid cyst with bulb irrigation to stop any bleeding after removal. It is not unusual with en block resection of the colloid cyst to see some hemorrhage after removal. Following neuroendoscopic resection of each colloid cyst, careful inspection of the lateral and third ventricles is performed to ensure complete removal of the colloid cyst capsule and contents (Fig. 9a). Any residual capsule or contents should be removed with the single action biopsy forceps. Endoscopic visualization of the third ventricle is also performed to visualize the contralateral foramen of Monro and ensure no obstruction (Fig. 9b). Any recurrent bleeding noted after endoscopic resection of the colloid cyst and thorough irrigation can be stopped by tissue hemostasis with the endoscopic bipolar cautery. Patency of the ventricular system is inspected several times with the LOTTA® 30°. Any small hematoma in the third ventricle after complete cyst resection is removed with the single action biopsy forceps to ensure patency of the ventricular space.

Endoscopic inspection of the third ventricle after colloid cyst resection and restoration of CSF communication. Close inspection of the third ventricle is performed to confirm complete removal of the colloid cyst capsule and contents (a). Visualization of the contralateral foramen of Monro and confirmation no obstruction is present (b). Placement of a septum pellucidum fenestration by the endoscopic bipolar cautery device (c).
5.1 Septum Pellucidum Fenestration

After complete neuroendoscopic colloid cyst resection, a septum pellucidum fenestration is performed to permit communication between both lateral ventricles. Due to the unilateral neuroendoscopic resection, a septostomy permits CSF flow to the contralateral lateral ventricle and drainage through the contralateral foramen of Monro. This avoids any potential unilateral obstruction of CSF flow through the ipsilateral foramen of Monro where the colloid cyst removal was performed. The endoscopic bipolar device is used to thermally coagulate an opening in the septum pellucidum through the working channel superior and posterior to the foramen of Monro (Fig. 9c). Care is taken not to place the septostomy immediately adjacent to the septal vein or the fornical bundle. Once the septostomy is completed, the LOTTA® 30° can be inserted through this opening to enlarge the perforation and visualize the contralateral lateral ventricle.

5.2 Placement of Temporary External Ventricular Drainage Catheter

An external ventricular drain (EVD) is advanced into the ipsilateral lateral or third ventricle to a depth of 6–7 cm upon complete neuroendoscopic colloid cyst removal. The EVD is tunneled under the skin posterior to the incision. Placement of the EVD permits drainage of any residual blood products over the course of 48–72 h. After 24 h of CSF drainage, elevation of the EVD to 20 cm above the external auditory canal is performed. The EVD is clamped thereafter for 24 h and then removed if the patient has no persistent symptoms of headaches, nausea, or vomiting. Rarely, will a patient not tolerate clamping of their EVD. If this is the case, a second attempt at weaning is made. If EVD removal is not possible, then a ventriculo-peritoneal shunt (VPS) may be required for CSF diversion. A small titanium plate with an opening for the EVD is placed over the burr hole for cosmetic purposes since the incision is so close to the forehead (Fig. 10a). The galea is reapproximated with 3-0 vicryl sutures sewn in an interrupted fashion. A running 4-0 monocryl is used to reapproximate the skin edges together (Fig. 10b). There is no need to remove the monocryl sutures as they will dissolve within 4 weeks.
Controlled Variable Aspiration Resection of Large Colloid Cysts

Larger colloid cysts with diameters close to or greater than 2 cm can be evacuated of their contents with the use of a variable aspiration tissue resector placed through the working channel prior to removal of the colloid cyst capsule. Use of the variable aspiration tissue resector permits decompression of the colloid cyst to lessen any traction on the fornical bundles during manipulation and dissection of larger diameter colloid cysts. Furthermore, decompression of larger colloid cysts can permit removal of the colloid cyst through the smaller diameter foramen of Monro.

Conclusions

The neuroendoscopic resection of colloid cysts is a truly minimally invasive procedure that can be routinely performed to completely resect colloid cysts in a safe manner. Use of the LOTTA® 30° set provides the neurosurgeon with an optimal view of the foramen of Monro after an anterolateral approach. Neuronavigation is essential to determine a trajectory to the frontal horn of the lateral ventricle and avoiding injury to the caudate nucleus when cannulating the ventricle. The LOTTA® 30° endoscope permits optimal visualization of instruments inserted through the working channel for the neuroendoscopic resection of colloid cysts. Judicious bipolar cautery of the choroid plexus and the colloid cyst (capsule and contents) is essential to the success of the procedure. Proper bipolar cautery of the colloid cyst permits shrinkage in size of the colloid cyst away from the fornix and the septal/thalamostriate venous complex. Bipolar cautery also is important for thermal coagulation of blood vessels leading to the colloid cyst capsule, especially at its base. Adequate bipolar coagulation of the blood vessels supplying the colloid cyst will minimize bleeding that occurs with complete resection. Care is taken to avoid thermal coagulation of the thalamostriate venous complex. Puncturing of the colloid cyst will permit further shrinkage of the colloid cyst and separation from the fornix and surrounding veins. The goal of the resection is en block removal of the colloid cyst if possible to ensure complete colloid cyst resection. Removal of the colloid cyst capsule and contents with the single action biopsy forceps by slowly removing the LOTTA® 30° scope will permit the en block resection. Bleeding after neuroendoscopic colloid cyst resection is not unexpected and will stop with proper irrigation of the ventricular system. Close inspection of the foramen of Monro and the third ventricle is performed to confirm there is no residual colloid cyst capsule or contents. Visualization of the contralateral foramen of Monro should be possible with complete colloid cyst resection. Larger colloid cysts can be decompressed of their contents with a variable aspiration tissue resector device prior to manipulation of the colloid cyst capsule.
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Recommended Instruments, Units and Videoendoscopic Equipment for Neuroendoscopic Colloid Cyst Resection
Neuro-Endoscope LOTTA® 30°
Operating Sheath, outer diameter 6.8 mm

- For diagnostic orientation in the ventricular system, the cerebellopontine angle, basal cisterns, arachnoidal cysts and and colloid cystic intracranial tumors
- For therapeutic interventions for ventriculostomies, stent implantations in the aquaduct, septostomies and tumor resections

28164 LAB/28164 LSB

28164 LO

28164 LP

28008 AA

28164 LAB Ventriculoscope LOTTA® HOPKINS®, wide angle telescope 30°, angled eyepiece, outer diameter 6.1 mm, length 18 cm, working channel diameter 2.9 mm, irrigation/suction channel diameter 1.6 mm, autoclavable, fiber optic light transmission incorporated, color code: red

28164 LSB Operating Sheath, graduated, rotating, outer diameter 6.8 mm, working length 13 cm, for use with Ventriculoscope LOTTA® 30° 28164 LAB

28164 LO Obturator, for Operating Sheath 28164 LS and 28164 LSB

28164 LP Optical Obturator, for positioning Operating Sheath 28164 LS and 28164 LSB under visual control, for use with Telescope HOPKINS® 28008 AA

28008 AA HOPKINS® Straight Forward Telescope 0°, enlarged view, diameter 2 mm, length 26 cm, autoclavable, fiber optic light transmission incorporated, color code: green

It is recommended to check the suitability of the product for the intended procedure prior to use.
Neuro-Endoscope
Operating Instruments for use with LOTTA® Ventriculoscope 28164 LAB and Operating Sheath 28164 LSB

CLICKLINE Instruments

Diameter 2.7 mm, working length 30 cm

- **28164 LB**
  - **CLICKLINE Biopsy Forceps**, rotating, dismantling, with Luer-Lock irrigation connector for cleaning, single action jaws, diameter 2.7 mm, working length 30 cm including:
    - **Metal Handle**, without ratchet
    - **Outer Sheath**, with forceps insert

Diameter 2 mm, working length 30 cm

- **28164 LB**
  - **CLICKLINE Scissors**, pointed, single action jaws, with Handle 30131, diameter 2 mm, working length 30 cm
- **28164 LC**
  - **CLICKLINE Biopsy Forceps**, double action jaws, with Handle 30131, diameter 2 mm, working length 30 cm
- **28164 LD**
  - **CLICKLINE Ventriculostomy Forceps**, with Handle 30131, diameter 2 mm, working length 30 cm
- **28164 LE**
  - **CLICKLINE Grasping Forceps**, double action jaws, with Handle 30131, diameter 2 mm, working length 30 cm

Diameter 1.7 mm, working length 30 cm

- **28162 EM**
  - **Scissors**, pointed, slightly curved jaws, double action jaws, diameter 1.7 mm, working length 30 cm

Diameter 1.3 mm, working length 30 cm

- **28162 FP**
  - **Scissors**, pointed, single action jaws, diameter 1.3 mm, working length 30 cm

Diameter 1 mm, working length 30 cm

- **28160 TV**
  - **Forceps**, for ventriculostomy, flexible, double action jaws, diameter 1 mm, working length 30 cm
- **28160 ZJ**
  - **Biopsy Forceps**, flexible, double action jaws, diameter 1 mm, working length 30 cm
Neuro-Endoscope
Operating Instruments for use with LOTTA® Ventriculoscope 28164 LAB and Operating Sheath 28164 LSB

Outer diameter 2.4 mm, working length 30 cm

28164 BDV

TAKE-APART® Bipolar Forceps,
long, with flat jaws, outer diameter 2.4 mm,
working length 30 cm
including:
Bipolar Ring Handle
Outer Sheath
Forceps Insert, for single use, package of 5

28164 LG

Guillotine Knife,
outer diameter 2.7 mm,
working length 30 cm
including:
Handle
Guillotine Knife Insert
Neuro-Endoscope
Diagnostic Telescopes for use with Operating Sheath 28164 LSB

Diameter 3.3 mm, length 25 cm

28007 AA  HOPKINS® Straight Forward Telescope 0°,
enlarged view, diameter 3.3 mm, length 25 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: green

28007 BA  HOPKINS® Forward-Oblique Telescope 30°,
enlarged view, diameter 3.3 mm, length 25 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: red

28007 FA  HOPKINS® Telescope 45°,
enlarged view, diameter 3.3 mm, length 25 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: black

533 TVA  Adaptor, autoclavable,
permits telescope changing under sterile conditions

28762 KB  Bipolar Coagulation Electrode,
diameter 1.7 mm, working length 30 cm
UNIDRIVE® S III NEURO SCB
Recommended Standard Set Configurations

*40701701-1 UNIDRIVE® S III NEURO SCB, motor control unit with color display, touch screen, two motor outputs, integrated irrigation pump and integrated SCB module, power supply 100–240 VAC, 50/60 Hz including:
- Mains Cord
- Irrigator Rod
- Two-Pedal Footswitch, two-stage, with proportional function
- Clip Set, for use with tubing set
- SCB Connecting Cable, length 100 cm
- Single Use Tubing Set*, sterile, package of 3

* Not available for sale in the U.S.A.

Specifications:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch Screen</td>
<td>8.4&quot;/300 cd/m²</td>
</tr>
<tr>
<td>Available languages:</td>
<td>English, French, German, Spanish, Italian, Portuguese, Greek, Turkish, Polish, Russian</td>
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<tr>
<td>Power supply</td>
<td>100–240 VAC, 50/60 Hz</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>300 x 165 x 265 mm</td>
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<tr>
<td>Weight</td>
<td>5.2 kg</td>
</tr>
<tr>
<td>Certified to</td>
<td>IEC 601-1, CE acc. to MDD</td>
</tr>
</tbody>
</table>
UNIDRIVE® S III NEURO SCB
High-Speed Micro Motor

Special Features:
- Self-cooling and brushless high-speed micro motor
- Smallest possible dimensions
- Autoclavable
- Can be processed in a cleaning machine
- Maximum torque 6 Ncm
- Number of revolutions can be continuously adjusted from 1000 – 60,000 rpm
- Possible to adjust the number of revolutions to 100,000 rpm with the appropriate handle

High-Speed Micro-Motor, max. speed 60,000 rpm, including connecting cable, for use with UNIDRIVE® S III ENT/NEURO

Accessories:
- Universal Spray, 6x 500 ml bottles – HAZARDOUS GOODS – UN 1950 including: Spray Nozzle
- Tubing Set, for irrigation, for single use, sterile, package of 10

* Not available for sale in the U.S.A.
**UNIDRIVE® S III NEURO SCB**

**Perforator Handpiece, 1200 rpm**

For use with Perforator Instruments with Hudson Connectors

Special Features:
- Lightweight, ergonomic handpiece for optimal force transmission
- Hudson connector
- For use in cranial surgery for adults and children

![Image of Perforator Handpiece](image)

252640

Perforator Handpiece, max. speed 1200 rpm, without perforator blade, Hudson connector, for use with High-Speed Micro-Motor 20 712033

*Not available for sale in the U.S.A.*
UNIDRIVE® S III NEURO SCB
Craniotome Handpiece, 60,000 rpm, High-Speed Craniotome Burrs

Special Features:
- High performance and very good operating features combined in one handpiece
- Optimal protection of the dura thanks to dura protectors available in three sizes – pediatric, medium, long

*252645

Craniotome Handpiece, max. speed 60,000 rpm, including medium dura protector, for use with High-Speed Micro-Motor 20 7120 33 as well as 3.17 mm craniotome burrs and suitable dura protector

*252646

Pediatric Dura Protector, for use with Craniotome Handpiece 252645

*252647

Medium Dura Protector, for use with Craniotome Handpiece 252645

*252648

Long Dura Protector, for use with Craniotome Handpiece 252645

* High-Speed Craniotome Burrs, 60,000 rpm, for single use, sterile, package of 5

<table>
<thead>
<tr>
<th>pediatric</th>
<th>medium</th>
<th>long</th>
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</thead>
<tbody>
<tr>
<td>360000 S</td>
<td>360000 M</td>
<td>360000 L</td>
</tr>
</tbody>
</table>

* Not available for sale in the U.S.A.
UNIDRIVE® S III NEURO SCB
High-Speed Handpieces, angled, 100,000 rpm

For use with drills with shaft diameter 3.17 mm

*252680  High-Speed Handpiece, short, angled, 100,000 rpm, for use with High-Speed Micro-Motor 20712033

*252681  High-Speed Handpiece, medium, angled, 100,000 rpm, for use with High-Speed Micro-Motor 20712033

*252682  High-Speed Handpiece, long, angled, 100,000 rpm, for use with High-Speed Micro-Motor 20712033

* Not available for sale in the U.S.A.
**UNIDRIVE® S III NEURO SCB**
For use with High-Speed Handpieces, 100,000 rpm

For use with High-Speed Handpieces, 100,000 rpm

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>short</th>
<th>medium</th>
<th>long</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>350110 S</td>
<td>350110 M</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>350120 S</td>
<td>350120 M</td>
<td>350120 L</td>
</tr>
<tr>
<td>3</td>
<td>350130 S</td>
<td>350130 M</td>
<td>350130 L</td>
</tr>
<tr>
<td>4</td>
<td>350140 S</td>
<td>350140 M</td>
<td>350140 L</td>
</tr>
<tr>
<td>5</td>
<td>350150 S</td>
<td>350150 M</td>
<td>350150 L</td>
</tr>
<tr>
<td>6</td>
<td>350160 S</td>
<td>350160 M</td>
<td>350160 L</td>
</tr>
<tr>
<td>7</td>
<td>350170 S</td>
<td>350170 M</td>
<td>350170 L</td>
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</table>

*High-Speed Standard Burrs, 100,000 rpm, for single use, sterile, package of 5*

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>short</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>350210 S</td>
<td>350210 M</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>350220 S</td>
<td>350220 M</td>
<td>350220 L</td>
</tr>
<tr>
<td>3</td>
<td>350230 S</td>
<td>350230 M</td>
<td>350230 L</td>
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<tr>
<td>4</td>
<td>350240 S</td>
<td>350240 M</td>
<td>350240 L</td>
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<tr>
<td>5</td>
<td>350250 S</td>
<td>350250 M</td>
<td>350250 L</td>
</tr>
<tr>
<td>6</td>
<td>350260 S</td>
<td>350260 M</td>
<td>350260 L</td>
</tr>
<tr>
<td>7</td>
<td>350270 S</td>
<td>350270 M</td>
<td>350270 L</td>
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</tbody>
</table>

*High-Speed Diamond Burrs, 100,000 rpm, for single use, sterile, package of 5*

* Not available for sale in the U.S.A.
UNIDRIVE® S III NEURO SCB
High-Speed Coarse Diamond Burrs, High-Speed Acorns, High-Speed Barrel Burrs, High-Speed Neuro Fluted Burrs

For use with High-Speed Handpieces, 100,000 rpm

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>short</th>
<th>medium</th>
<th>long</th>
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<tbody>
<tr>
<td>3</td>
<td>350330 S</td>
<td>350330 M</td>
<td>350330 L</td>
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<tr>
<td>4</td>
<td>350340 S</td>
<td>350340 M</td>
<td>350340 L</td>
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<td>5</td>
<td>350350 S</td>
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<td>350360 S</td>
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</tr>
<tr>
<td>7</td>
<td>350370 S</td>
<td>350370 M</td>
<td>350370 L</td>
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</table>

<table>
<thead>
<tr>
<th>Diameter in mm</th>
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<tbody>
<tr>
<td>7.5</td>
<td>350675 S</td>
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<td>9</td>
<td>350690 S</td>
<td>350690 M</td>
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</table>

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>short</th>
<th>medium</th>
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<tr>
<td>6</td>
<td>350960 S</td>
<td>350960 M</td>
</tr>
<tr>
<td>9.1</td>
<td>350991 S</td>
<td>350991 M</td>
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</table>

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>short</th>
<th>medium</th>
<th>long</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8</td>
<td>350718 S</td>
<td>350718 M</td>
<td>350718 L</td>
</tr>
<tr>
<td>3</td>
<td>350730 S</td>
<td>350730 M</td>
<td>350730 L</td>
</tr>
</tbody>
</table>

* High-Speed Coarse Diamond Burrs, 100,000 rpm, for single use, sterile, package of 5

* High-Speed Acorns, 100,000 rpm, for single use, sterile, package of 5

* High-Speed Barrel Burrs, 100,000 rpm, for single use, sterile, package of 5

* High-Speed Neuro Fluted Burrs, 100,000 rpm, for single use, sterile, package of 5

* Not available for sale in the U.S.A.
Holding Systems
POINT SETTER® Pneumatic Holding System

28163 WS POINT SETTER®, pneumatic holding arm, set including:
POINT SETTER® Arm
OR Table Adaptor
KSLOCK Adaptor, for KARL STORZ clamping jaws
KARL STORZ Clamping Jaw, large
KARL STORZ Clamping Jaw, small
KARL STORZ Clamping Jaw, for fiberscopes
Pressure Regulator, 7 bar
Drape, for single use, sterile, package of 10

Note: Compressed air tubing is required to operate the POINT SETTER® arm. Please select the appropriate tubing and add it to your order.

Pressure hoses and accessories for the POINT SETTER®:
28172 WA Connecting Tube, for POINT SETTER®, Dräger, max. pressure 8 bar/115 psi, length 600 cm
28172 WB Connecting Tube, for POINT SETTER®, Dräger air motor, max. pressure 8 bar/115 psi, length 600 cm
28172 WC Connecting Tube, for POINT SETTER®, compressor, max. pressure 8 bar/115 psi, length 600 cm
28172 WN Connecting Tube, for POINT SETTER®, Schrader, max. pressure 8 bar/115 psi, length 600 cm
28172 WO Connecting Tube, for POINT SETTER®, with open end, max. pressure 8 bar/115 psi, length 600 cm
28272 CN Clamping Cylinder, folding, for flexible mounting of 10 mm telescopes to telescope sheath, autoclavable. The clamping cylinder allows vertical movement and rotation of the telescope. For use with Clamping Jaw 28272 UGN, 28272 UGK and POINT SETTER® universal adaptor 10-15 mm

041150-20* Cover, elasticsed, 42 x 164 cm, for single use, sterile, for use with KARL STORZ holding arms, package of 20
041150-80* Same, package of 80
With the IMAGE1 S™ camera platform, KARL STORZ once again sets a new milestone in endoscopic imaging, consolidating their reputation as an innovative leader in minimally invasive surgery. The IMAGE1 S™ camera platform offers surgeons a single system for all applications. As a modular camera platform, IMAGE1 S™ combines various technologies (e.g., rigid, flexible and 3D endoscopy) in one system and can therefore be adapted to individual customer needs. Furthermore, near infrared (NIR/ICG) for fluorescence imaging, the integration of operating microscopes and the use of VITOM® 3D exoscopes is possible via the camera platform.

Brilliant imaging

- Versatile visualization options for diagnosis and therapy
- Innovative S-Technologies for easy differentiation of tissue structures
- Clear and razor-sharp imaging
- Natural color rendition
- Automatic light source control

**CLARA:** Homogeneous illumination

*CLARA + CHROMA:* Homogeneous illumination + contrast enhancement

*SPECTRA A:* Color hue shift and exchange (filtering reds)

*SPECTRA B:* Spectral color shift (intensification of greens and blues)

* SPECTRA A: Not available for sale in the U.S.A.
* SPECTRA B: Not available for sale in the U.S.A.
**IMAGE1 S™**

As individual as your requirements

**Innovative Design**
- Side-by-side View: Parallel display of standard image and visualization mode possible
- Multiple source management: Simultaneous control, display and documentation of two image sources possible (e.g., hybrid procedures)
- Intuitive user guidance (dashboard, live menu and setup menu)
- Intelligent icons display settings and status
- Individual presets possible
- 50 patient data records can be archived

**Economical and futureproof**
- Modular platform: Rigid, flexible and 3D technology can be selected according to individual preferences
- Easy integration of new technologies
- Forward and backward compatibility
- No additional equipment (e.g., special light sources) required for S-Technologies

* SPECTRA A: Not available for sale in the U.S.A.
* SPECTRA B: Not available for sale in the U.S.A.
IMAGE1 S™
As individual as your requirements

IMAGE1 S™ 3D
IMAGE1 S™ 3D is a further component in the IMAGE1 S™ camera platform. The 3D system provides surgeons with excellent depth perception. Furthermore, the 3D stereoscopic imaging system is particularly valuable for activities that demand a high degree of spatial perception. The 3D camera platform from KARL STORZ impresses with its wide range of applications – from laparoscopy, gynecology, ENT to microsurgical interventions.

Benefits of IMAGE1 S™ 3D
- Brilliant and razor-sharp imaging in 2D and 3D
- Switchover from 3D to 2D at the touch of a button
- Easy integration into the IMAGE1 S™ platform
- CLARA, CHROMA, SPECTRA* in 2D and 3D
- 3D system with video endoscopes with diameters of 10 mm and 4 mm as well as VITOM® 3D

Benefits of 3D integration into the IMAGE1 S™ camera platform
- Communication between all units
- One system for multiple applications
- Reduced space requirements
- One user interface for all applications
- Synergy effects between the OR workflow and financing

* SPECTRA: Not available for sale in the U.S.A.
IMAGE1 S™ – A System for all Requirements

Connects all technologies IMAGE1 S CONNECT™

10 mm 3D video laparoscope

4 mm 3D video endoscope

Flexible video endoscopes

2D endoscopy IMAGE1 S™ X-LINK

3D endoscopy IMAGE1 S™ D3-LINK™

Open to future technologies

e.g., 4K/UHD

3-chip camera heads

Near Infrared (NIR/ICG) 3-chip camera head FI

PDD camera heads

Microscopy camera head

1-chip camera heads

IMAGE1 S™ – A System for all Requirements
**IMAGE1 S™ Camera System**

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

<table>
<thead>
<tr>
<th>Specifications:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HD video outputs</td>
<td>- 2x DVI-D</td>
</tr>
<tr>
<td></td>
<td>- 1x 3G-SDI</td>
</tr>
<tr>
<td>Format signal outputs</td>
<td>1920 x 1080p, 50/60 Hz</td>
</tr>
<tr>
<td>LINK video inputs</td>
<td>3x</td>
</tr>
<tr>
<td>USB interface</td>
<td>4x USB, (2x front, 2x rear)</td>
</tr>
<tr>
<td>SCB interface</td>
<td>2x 6-pin mini-DIN</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–120 VAC/200–240 VAC</td>
</tr>
<tr>
<td>Power frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Protection class</td>
<td>I, CF-Defib</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>305 x 54 x 320 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>2.1 kg</td>
</tr>
</tbody>
</table>

For use with **IMAGE1 S CONNECT™** Module TC 200EN

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

<table>
<thead>
<tr>
<th>Specifications:</th>
<th>TC 300 (H3-Link)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera System</td>
<td>TH 100, TH 101, TH 102, TH 103, TH 104, TH 106 (fully compatible with IMAGE1 S™)</td>
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<tr>
<td></td>
<td>22220055-3, 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>
<td>1x</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–120 VAC/200–240 VAC</td>
</tr>
<tr>
<td>Power frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Protection class</td>
<td>I, CF-Defib</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>305 x 54 x 320 mm</td>
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<tr>
<td>Weight</td>
<td>1.86 kg</td>
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</tbody>
</table>

* **SPECTRA A**: Not available for sale in the U.S.A. **SPECTRA B**: Not available for sale in the U.S.A.
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 ( \frac{1}{3}'' ) CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 114 mm</td>
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<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 \text{ 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>
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</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>
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<tr>
<th>IMAGE1 FULL HD Camera Heads</th>
<th>IMAGE1 S™ H3-ZA</th>
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<tbody>
<tr>
<td>Product no.</td>
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<td>Image sensor</td>
<td>3x ( \frac{1}{3}'' ) CCD chip</td>
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<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 \text{ Lux} )</td>
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<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
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<tr>
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<td>Cable length</td>
<td>300 cm</td>
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Notes:

Please note that the described products in this medium may not be available yet in all countries due to different regulatory requirements.
with the compliments of
KARL STORZ — EN DOSKOPE