APPLICATION OF THE LOTTA® VENTRICULOSCOPY SYSTEM IN CLINICAL PRACTICE

Second Edition

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### Online Video Content

The author has contributed a series of topic-related video clips which are readily identified in the table of contents (1) and in the text by a play button with accompanying number and title (see below). Click on the play button to view the video clip in your internet browser.

1. Cutting Technique with Guillotine Knife

As an alternative option, just scan the QR Code or enter the short link to access the online video content.

http://go.karlstorz.com/96025017-en-1
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**Recommended Sets for Neuro-Endoscopy – Intracranial Surgery**

- **The Standard and Little LOTTA® Ventriculoscopes**
- **Telescopes, Sheaths, Instruments and Powered Instrumentation**
- **POINT SETTER® Pneumatic Holding System**
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Acknowledgment

First and foremost, I wish to thank my colleagues Drs. Jörg Baldauf, Steffen Fleck, Jan-Uwe Müller, Christian Rosenstengel, Dirk-Thomas Pillich, Michael Fritsch and my fellows from abroad, Anna Katharina Krähenbühl, Ehab El Refae, Ahmed El Damaty, and Jotham Manwaring, for using the LOTTA® ventriculoscopic system in our operating room and for giving their feedback on the handling of the system.

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The Author.
Introduction

This book describes the LOTTA® ventriculoscopic system and its application in daily clinical practice. It reflects the experience gathered at the author's institution. The idea to develop a new ventriculoscope came from some shortcomings that we recognized when using neuroendoscopes commercially available on the market. The LOTTA® system combines the advantages of several older neuroendoscopic systems and provides some new features. The HOPKINS® rod-lens system offers an excellent image quality. The working channels greatly facilitate a precise guidance of instruments at the tip of the endoscope and allow bimanual dissection, if required. Because of the size of the main working channel (2.9 mm), an effective tissue removal and rapid evacuation of colloid cysts is possible. For orientation and panoramic inspection, diagnostic endoscopes with 0°, 30° and 45° angles of view are also available.

This system can be used for all intracranial endoscopic procedures, such as:

- Third ventriculostomy.
- Septostomy, foraminoplasty.
- Aqueductoplasty.
- Stenting.
- Colloid cyst removal.
- Pinal cyst fenestration.
- Arachnoid cyst fenestration.
- Intraparenchymal cyst fenestration.
- Intraventricular tumor biopsy or resection.
- Blood clot removal.
- Lavage in the treatment of ventriculitis and intraventricular hemorrhage.

The LOTTA® is a universal neuroendoscopic system that allows any type of endoscopic intraventricular procedure to be performed in any age group.²¹

Description of the LOTTA® System

The LOTTA® system includes several endoscopes, trocars, sheaths, and instruments. The three ventriculoscopes are the central part of the system (Fig. 2.1). Each consists of an endoscope, an endoscopic sheath, a trocar, and an optical trocar (Fig. 2.2). The Standard LOTTA® is available with a 6° and a 30° scope.

Fig. 1.1 Lotta Schroeder, the author’s daughter, at the age of 4 years.

Fig. 2.1 The three ventriculoscopes are the core components of the LOTTA® system.

Fig. 2.2 The LOTTA® ventriculoscope consists of the endoscope ①, endoscope sheath ②, trocar ③, and optical trocar ④.
The standard LOTTA® has an outer diameter of 6.1 mm, while the little LOTTA® measures 3.6 mm (Fig. 2.3). The outer diameter of the sheath is 6.8 mm and 4.5 mm respectively. The working length of all scopes is 14 cm. To facilitate a precise insertion of the endoscope, length markings are given on the outer surface of the sheath (Fig. 2.4). The sheath of the neuroendoscope is a key component of the system. It can be used for tissue retraction, e.g., during exposure of a cyst membrane located under brain parenchyma. Furthermore, the endoscope can be withdrawn into the sheath for 4 to 8 mm to create an artificial space in front of the endoscope tip. This is helpful in narrow cavities to provide some working space. In case of hemorrhage, the endoscope sheath is positioned such that its distal opening is located exactly over the bleeding vessel so that most of the blood drains into the sheath. In turn, it is a straightforward matter to clear vision by forced irrigation, identify the bleeding spot, and coagulate the vessel.

Prior to insertion of the sheath, a trocar is introduced into the latter and locked (Fig. 2.4). The trocar is equipped with a blunt tip for easy insertion of the sheath into ventricles or cysts (Fig. 2.5). In addition, there is an optical trocar with a 2.0-mm rod-lens scope which allows visual control while advancing the scope into the brain or while passing a narrow foramen of Monro (Fig. 2.6). The standard LOTTA® contains a 1.7-mm rod lens system, light fibers, a 2.9-mm main working channel, and two 1.6-mm side channels that can be used for irrigation and/or insertion of a second instrument for bimanual dissection (Fig. 2.7).

The little LOTTA® contains a 1.2 mm rod lens, light fibers, a 1.6-mm main working channel, and two 0.8-mm side channels, that can be used for irrigation (Fig. 2.7). The rod lens system of the 6° or 30° HOPKINS® endoscope provides an outstanding optical quality which requires less light for adequate visualization. The field of view is 77°. Even in cloudy (protein-rich or bloody) cerebrospinal fluid (CSF), vision is mostly sufficient to keep one's bearings and...
to continue surgery. Of course, resolution of the standard LOTTA® is higher than that of little LOTTA® due to the larger lens diameter (Fig. 2.8).

The main working channel of the standard LOTTA® is matched to 2.7-mm rigid instruments, the use of which is essential to the effective removal of tissue when dealing with tumors. Furthermore, an 8-French tracheal suction catheter may be introduced via the main working channel and used for colloid cyst evacuation. The working channels enable an accurate guidance of instruments. In case large portions of tissue need to be removed, the grasping forceps is retracted together with the scope out of the sheath. In this way, the whole inner diameter of the sheath can be used. In smaller side channels, instruments of 1.2 mm can be used. However, these instruments need to be flexible because the channels are curved at the proximal inlet. Of course, tactile feedback is much better when using rigid instruments in the main working channel. Accordingly, a side channel is used mainly when bimanual dissection is required (Fig. 2.9).
The funnel-shaped entry port has been specifically designed to facilitate insertion of instruments into the main channel. The side channels have Luer-lock ports for connection of irrigation tubes (Fig. 2.10). The sheath can be attached to an endoscope holder providing a fixed, non-rotating connection (Fig. 2.11). A recently added technical feature allows the user to rotate the scope together with the sheath, eliminating the need for unlocking the connection with the holder. This is enabled by a rotation mechanism integrated in the sheath that can be locked/unlocked with a screw (Fig. 2.12).

Neuronavigation can easily be used with the LOTTA® system. A reference frame can be simply attached to the sheath (Fig. 2.13). Even if the need arises during surgery to change endoscopes, navigational guidance is maintained.

For the LOTTA® ventriculoscope, several 1.8-mm instruments, such as a ventriculostomy forceps, a biopsy forceps, a grasping forceps, and sharp-pointed scissors are available. Additionally, a larger 2.7-mm tumor forceps for effective tissue removal is available (Fig. 2.14). The modular design of ‘Clickline’ instruments allows any type of instrument shaft to be used in combination with one handle (Fig. 2.14).
Instruments can be freely rotated with the aid of an adjustment wheel integrated in the shaft and helps to diminish fatigue from repetitive wrist rotation (Fig. 2.15). In order to enhance safety during introduction of instruments via the working channel into the brain, length markings are engraved on the instrument shaft (Fig. 2.16). Once the marking appears at the outer rim of the funnel-shaped entry port (Fig. 2.16), the instrument tip has precisely arrived at the distal end of the endoscope (Fig. 2.16a).

The marking aids the surgeon in preventing the risk of inadvertently advancing the instrument too far and overshooting the stand-by position. In this way, the risk of iatrogenic injury to the surrounding brain tissue can be reduced to the very minimum. Apart from scissors, a guillotine knife is available for cutting purposes. This instrument is particularly useful for cutting membranes overlying nerves or vessels (Fig. 2.17).

A bipolar diathermic electrode and bipolar forceps are available for hemostasis (Figs. 2.18).

---

**Fig. 2.15** Rotation of a Clickline instrument with the aid of a small wheel integrated in the shaft.

**Fig. 2.16** Engraved on the instrument shaft is a length marking (red pointers) designed to alert the operating surgeon to the fact that the instrument tip has arrived at the distal end of the endoscope (a).

**Fig. 2.17** Guillotine knife.

**Fig. 2.18** Bipolar forceps ① and coagulation electrode ②.
For bimanual dissection, a slim, flexible grasping forceps is offered that can be introduced via one of the irrigation channels (Fig. 2.19a). A puncture needle is included for puncture and aspiration of cysts (Fig. 2.19b).

For the Little LOTTA® ventriculoscope, small-calibre instruments are available, that are specifically adapted to the smaller lumen of the working channel (1.6 mm) (Fig. 2.20). The range of instruments comprises a ventriculostomy forceps, biopsy forceps, grasping forceps, and sharp-pointed scissors (Figs. 2.21). For hemostasis, a bipolar electrode is available (Figs. 2.21).

A balloon catheter is used to enlarge a ventriculostomy or other fenestrations (Fig. 2.22). The main working channel of both LOTTA® scopes allows the use of 3-French catheters.

For further inspection, 3.3-mm diagnostic endoscopes with 0°, 30°, and 45° angle of view are available. They are equipped with a 2-mm rod-lens system which offers an outstanding image quality (Fig. 2.23).
For inspection of small cavities or exploration of the aqueduct, 2-mm endoscopes (1.2-mm rod-lens system) with 0° and 30° angle of view are available (Fig. 2.24).

For cleaning and sterilization, use of a special container is recommended (Fig. 2.25).

### Additional Endoscopic Equipment

Usually, all endoscopic intracranial procedures can be performed with rigid endoscopes. Although the use of flexible ‘chip-on-the-tip’ endoscopes has gained more widespread acceptance in the field, the author still prefers the use of rigid HOPKINS® rod-lens endoscopes because of their brilliant optical quality and extreme wide-angle view – distinguishing features that enhance orientation and guidance. To date, HOPKINS® scopes coupled to a HD or 4K camera offer the best image quality. In neuroendoscopy, the endoscope diameter has to be small which limits the resolution of the ‘chip-on-the-tip’ technology. Traditional flexible scopes have the drawback of poor image quality owing to a blurred, honeycomb-like pattern. The author prefers to use flexible scopes only very rarely to inspect the fourth ventricle via the aqueduct or the temporal horn.

The use of a Xenon cold light source is recommended because its color temperature resembles that of sunlight (6000 K), thus offering the best illumination conditions (Fig. 3.1). Light transmission from the light source to the scope is accomplished by cables that are equipped with glass fibers (Fig. 3.2) or a fluid medium (the latter type of cables offers a better light transmission, but is more susceptible to kinking).
Digital high definition (HD) 3-chip miniature video cameras should be used in neuroendoscopy whenever possible (Fig. 3.3). Compared to standard video cameras (PAL or NTSC), HD cameras have a fivefold larger resolution (approx. 2 Mio pixels) and a much better color fidelity. The image quality is excellent. Several functions of the digital video cameras, such as contrast or brightness, white balance etc., can be controlled directly via fingertip control using push-buttons on the camera. The HD camera is coupled to the scope via a sterile optical adapter allowing to change endoscopes under sterile conditions (Fig. 3.4). HD flat-panel monitors of various sizes are available to display the image (Fig. 3.5). Endoscopic procedures can be recorded for documentation purposes with the aid of an AIDA® documentation system (KARL STORZ Tuttlingen, Germany) (Fig. 3.6) suitable for full HD recording. Patient data is easily entered using a touch screen panel (Fig. 3.6). No assisting personnel is needed to control the unit’s recording function – the surgeon can do this independently by use of a footswitch pedal (Fig. 3.6). All videoendoscopic equipment should be stored on a mobile video cart or a ceiling-mounted boom arm (Fig. 3.6). The use of a mechanical (Fig. 3.7a) or pneumatic (Fig. 3.7b) endoscope holder is highly recommended since it allows the endoscopic sheath to be mounted and fixed in position as determined by individual requirements.
Selection of the Ventriculoscope

The most appropriate ventriculoscope is selected based on the individual anatomy of the patient and the procedure to be performed (Table 4.1). The Little LOTTA® is not a neuroendoscope used exclusively in pediatric patients. It can be used effectively also in adults, e.g., with small ventricles or a narrow foramen of Monro. For third ventriculostomy, we commonly use the Little LOTTA®. Furthermore, the Little LOTTA® is indicated in newborns and premature newborns. Tumor biopsies and cyst fenestrations can be done with the Little LOTTA® too. The standard LOTTA® can be used for all endoscopic intraventricular procedures, provided the ventricles are of adequate size. Use of the standard LOTTA® is especially indicated in the removal of colloid cysts, tumor resection, stent placement, and fenestration of intraparenchymal and arachnoid cysts.

Even though we usually prefer the use of 6° ventriculoscopes in most endoscopic procedures, the 30° LOTTA® provides advantages in specific circumstances. Taking into account that the 30° view is angled towards the working channel, instruments are visualized earlier than with the 6° scope (Fig. 4.1). Therefore, use of the 30° LOTTA® is particularly recommended in narrow cavities. Furthermore, when dissection of tumors or cysts is performed, the 30° view provides information about distant structures to which the lesion is attached, e.g., during resection of colloid cysts, the tela choroidea at the roof of the third ventricle can be visualized. Last but not least, the 30° LOTTA® is a valuable addition to the LOTTA® system, since many endoscopic neurosurgeons prefer the use of a 30° ventriculoscope in their daily practice. The superb image quality is the same as with the 6° LOTTA®. Use of the 30° LOTTA® is mainly recommended for resection of intraventricular tumors and colloid cysts. However, all other endoscopic procedures can be performed with the 30° LOTTA® as well.

<table>
<thead>
<tr>
<th>Standard LOTTA®</th>
<th>Little LOTTA®</th>
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<tbody>
<tr>
<td>Large ventricles</td>
<td>Small ventricles</td>
</tr>
<tr>
<td>Large foramen of Monro</td>
<td>Small foramen of Monro</td>
</tr>
<tr>
<td>Adults and children</td>
<td>Premature newborns, newborns, children and adults</td>
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<tr>
<td>Ventriculostomy, septostomy and foraminoplasty</td>
<td>Ventriculostomy, septostomy and foraminoplasty</td>
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<tr>
<td>Colloid cyst removal and stent placement</td>
<td>Stent placement with the stent inserted outside and parallel to the ventriculoscope</td>
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<td>Tumor resections</td>
<td>Tumor biopsies</td>
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<td>Cyst fenestrations</td>
<td>Cyst fenestrations</td>
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<td>Lavage</td>
<td>Lavage</td>
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Table 4.1 Indications of the Standard LOTTA® and Little LOTTA® ventriculoscopes.

Fig. 4.1 Representative imagery captured with the LOTTA® ventriculoscopes, directions of view 30° (a, c) and 6° (b, d).
Intraventricular Anatomy

As a matter of course, in-depth knowledge of the intraventricular anatomy is of paramount importance for patient safety during surgery. Profound anatomical knowledge plays an even more significant role when faced with a distorted anatomy, which mandates that anatomical bearings be established by identification of critical landmarks. In chronic hydrocephalus, a marked brain atrophy with enlargement of the foramen of Monro, multiple septal perforations, and thinning of fornices are frequently encountered. With the diagnostic scopes which are included in the LOTTA® set, the ventricles can be inspected widely. By on-axis rotation through 360°, the 30° and 45° endoscopes provide a radar-like panoramic view.

5.1 Lateral Ventricle

The endoscope is inserted via a standard precoronal burrhole into the right lateral ventricle (Fig. 5.1). At first, a 0° endoscope is used. The foramen of Monro with fornix, choroid plexus, thalamostriate, septal, and choroidal vein is seen (Fig. 5.2). The foramen is very variable in size and shape (Figs. 5.3a–f). The same is true for the veins. Occasionally, there is only one large vein or there are additional small veins, such as a foraminal vein.

Fig. 5.1 Endoscope trajectory for right lateral ventriculoscopy.

Fig. 5.2 Foramen of Monro.

Fig. 5.3 Various foramina of Monro.

Key to Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
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<tr>
<td>AC</td>
<td>anterior commissure</td>
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<tr>
<td>C</td>
<td>choroidal vein</td>
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<td>F</td>
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<tr>
<td>Sv</td>
<td>septal vein</td>
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<td>T</td>
<td>thalamostriate vein</td>
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Using the 30° endoscope to look anteriorly, the frontal horn is visualized. A distinctive feature of the frontal horn is the lack of choroid plexus (Fig. 5.4). The white matter is the corpus callosum and the gray matter laterally is the head of the caudate nucleus. Looking backwards, the central part of the lateral ventricle with thalamus, choroid plexus, and septum pellucidum is seen (Fig. 5.5).

With the 45° endoscope, visualization can be further extended. Looking straight ahead, the frontal horn is explored. The white matter of the corpus callosum and the gray matter of the head of the caudate nucleus is clearly seen (Fig. 5.6). Looking backwards, the central part of the lateral ventricle with thalamus, choroid plexus, and septum pellucidum come into view (Fig. 5.7). The choroid plexus can be followed until it turns into the temporal horn (Fig. 5.7, ➞). In chronic hydrocephalus, frequently, the septum has multiple perforations or is all but entirely absent, leaving the vessels behind (Fig. 5.8).

**Fig. 5.4** Frontal horn.

**Fig. 5.5** Central part of the lateral ventricle.

**Fig. 5.6** Frontal horn.

**Fig. 5.7** Central part of the lateral ventricle. Direction (➞) to the temporal horn.

**Fig. 5.8** Perforated septi.

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5.2 Third Ventricle

Next, the endoscope is advanced into the third ventricle. Using the 0° endoscope, the floor of the third ventricle with infundibular recess, mamillary bodies, and tuber cinerium is seen (Fig. 5.9). In most patients, the basilar artery can be recognized under the floor, which may have a variable appearance (Fig. 5.10). In chronic hydrocephalus, the floor is usually translucent. The basilar artery and clivus, sometimes even the posterior communicating artery, the P1 segments of the posterior cerebral artery, and the oculomotor nerve are visualized. Using the 30° endoscope looking anteriorly, the optic chiasm and the anterior cerebral artery complex shining through the thin lamina terminalis is visible (Fig. 5.11). Rotating the endoscope 180° to look backwards, the posterior third ventricle with posterior commissure, habenular commissure, pineal recess, and entry into the aqueduct is seen (Fig. 5.12).

Looking anteriorly with the 45° endoscope, the optic chiasm is seen and anterior cerebral artery complex is discernible through the thin lamina terminalis (Fig. 5.13).

---

Key to Acronyms

- **A**: anterior cerebral artery complex
- **Aq**: entry into the aqueduct
- **B**: basilar artery
- **Cl**: clivus
- **HC**: habenular commissure
- **I**: infundibular recess
- **L**: lamina terminalis
- **M**: mamillary bodies
- **O**: optic chiasm
- **OC**: oculomotor nerve
- **P1**: P1 segments of the posterior cerebral artery
- **PC**: posterior communicating artery
- **pC**: posterior commissure
- **Tc**: tuber cinerium
Rotating the 45° endoscope to the left, the left fornix and anterior commissure come into view (Fig. 5.14). Looking more laterally, shows the contralateral foramen of Monro (Fig. 5.15). Looking posteriorly, the massa intermedia is seen (Fig. 5.16). By advancing the endoscope further into the third ventricle, the posterior third ventricle with posterior commissure, habenular commissure, pineal recess, entry into the aqueduct, and roof of the third ventricle is seen (Fig. 5.17). The appearance of this region is highly variable too (Fig. 5.18).

**Key to Acronyms**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>aC</td>
<td>anterior commissure</td>
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<tr>
<td>Aq</td>
<td>entry into the aqueduct</td>
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<tr>
<td>F</td>
<td>fornix</td>
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<td>HC</td>
<td>habenular commissure</td>
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<td>L</td>
<td>lamina terminalis</td>
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<td>M</td>
<td>massa intermedia</td>
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<td>O</td>
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<tr>
<td>pC</td>
<td>posterior commissure</td>
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<tr>
<td>PG</td>
<td>pineal gland</td>
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<tr>
<td>R</td>
<td>roof of the third ventricle</td>
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5.3 Fourth Ventricle

Inspection of the fourth ventricle via the aqueduct is rarely necessary. Routinely, the author adopts this route only in a trapped fourth ventricle prior to inserting the stent to make sure that the fourth ventricle is accessible. Usually, a flexible scope is required to enter the fourth ventricle through the aqueduct because the latter in most cases is not a straight tube, but rather assumes a curved shape. Occasionally, given a straight aqueduct, a small rigid scope can be used to visualize the fourth ventricle. The occluded foramina of Luschkae and Magendi as well as the floor of the rhomboid fossa can be identified (Fig. 5.19).

5.4 Prepontine Cistern

Once the third ventriculostomy has been completed, the interpeduncular and prepontine cisterns are inspected to make sure that the passage through the subarachnoid spaces is adequately sized. Accordingly, viewing in a posterior direction, the 30° diagnostic scope is advanced via the stoma into the interpeduncular cistern. The basilar artery with its branches can be seen in the prepontine cistern (Fig. 5.20). Subject to the position of the basilar artery, occasionally, the basilar apex can be visualized (Fig. 5.21). Turning the scope to the right or left sometimes allows to identify the oculomotor nerve running between superior cerebellar and posterior cerebral artery (Figs. 5.22a–c).

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<thead>
<tr>
<th>Key to Acronyms</th>
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<th>basilar artery</th>
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<td>BA</td>
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<tr>
<td>CI</td>
<td>clivus</td>
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<tr>
<td>FL</td>
<td>occluded foramen of Luschkae</td>
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<td>FM</td>
<td>occluded foramen of Magendi</td>
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<td>OC</td>
<td>oculomotor nerve</td>
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<td>Pca</td>
<td>posterior cerebral artery</td>
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<tr>
<td>RF</td>
<td>floor of the rhomboid fossa</td>
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<tr>
<td>Sca</td>
<td>superior cerebellar artery</td>
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Fig. 5.19 Fourth ventricle.

Fig. 5.20 Prepontine cistern.

Fig. 5.21 Basilar apex.

Fig. 5.22 Oculomotor nerve running between superior cerebellar and posterior cerebral artery.
Given a wide prepontine cistern, abducens nerve, anterior inferior cerebellar artery, and vertebrobasilar junction are visible as well (Fig. 5.23). Looking more laterally, the posterior inferior cerebellar artery and the lower cranial nerve group can be appreciated (Fig. 5.24). Looking anteriorly, shows the diaphragm sellae covering the pituitary gland and the clivus with the dorsum sellae (Fig. 5.25).

**Fig. 5.23** Prepontine cistern.

**Fig. 5.24** Lateral prepontine cistern. Lower cranial nerve group (➞).  

**Fig. 5.25** Looking anteriorly exhibits the diaphragm sellae covering the pituitary gland and the clivus with the dorsum sellae.

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### Key to Acronyms

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<tr>
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<tbody>
<tr>
<td>AI</td>
<td>anterior inferior cerebellar artery</td>
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<td>AN</td>
<td>abducens nerve</td>
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<td>B</td>
<td>basilar artery</td>
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<tr>
<td>DS</td>
<td>dorsum sellae</td>
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<tr>
<td>Pg</td>
<td>pituitary gland</td>
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<td>PI</td>
<td>posterior inferior cerebellar artery</td>
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<td>V</td>
<td>vertebral artery</td>
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General Principles of the Endoscopic Technique

All procedures are performed under general anesthesia. The head is placed in a horseshoe-shaped headrest or, when neuronavigation is used, in three-pin fixation. Antibiotics are given as a single shot after induction of anesthesia (usually cefuroxim). The most appropriate entry point is determined such that a straight track to the region of interest can be adopted. If neuronavigation is not used, the site of the burr hole is defined according to the most appropriate trajectory obtained from CT or MR imaging. The head should be positioned such that the burr hole can be made at an elevated level to avoid excessive egress of CSF. In the presence of enlarged ventricles, the endoscopic sheath is inserted free-hand for standard procedures such as third ventriculostomy. If neuronavigation is not used, the site of the burr hole is defined according to the most appropriate trajectory obtained from CT or MR imaging. The head should be positioned such that the burr hole can be made at an elevated level to avoid excessive egress of CSF. In the presence of enlarged ventricles, the endoscopic sheath is inserted free-hand for standard procedures such as third ventriculostomy. If the optimal entry point is at an unusual location such as for septum pellucidum fenestration, neuronavigation is useful, but not mandatory. However, in the treatment of colloid and Sylvian arachnoid cysts, neuronavigation is routinely used to establish the ideal trajectory leading to the target area.

In addition, neuronavigation is applied in small ventricles or when there are no landmarks to be expected, such as in intraparenchymal cysts. In case of asymmetrical ventricles or size of the foramen of Monro, the approach should be made via the larger cavity. If feasible, the entry point should be located opposite to the dominant hemisphere. Once a 3-cm scalp incision has been made, a 10-mm burr hole is placed (Fig. 6.1). Usually, the skin incision is straight, but if a CSF reservoir needs to be implanted, a curvilinear incision is placed around the burr hole. Once the dura has been opened in a cross-shaped fashion, the cortex is coagulated. Initially, the ventricle is punctured with a Scott cannula in order to check the accuracy of the trajectory and to obtain a CSF sample for lab testing (Fig. 6.2). The endoscopic sheath containing the trocar, is mounted to a pneumatic holder (POINT SETTER®), that is covered by a sterile drape (Fig. 6.3a). Usually, the endoscopic sheath is inserted free-hand into the ventricle (Fig. 6.3b).
Given the use of neuronavigation, a dynamic reference frame (DRF) is attached to the sheath (Fig. 6.4a). Then, the sheath is inserted into the ventricle or cyst under navigational guidance (Fig. 6.4b). The DRF is attached to the endoscopic sheath to allow intraoperative navigation throughout the entire procedure, even while changing endoscopes during surgery (Fig. 6.5). Once the sheath has been inserted, the trocar is removed and the ventriculoscope or a diagnostic scope is introduced into the sheath. Following inspection of the cavity and identification of the main landmarks, the endoscopic procedure is initiated. Continuous irrigation is not necessary routinely. In case of hemorrhage, a 100-ml syringe, connected to one of the irrigation ports of the ventriculoscope via a plastic tube, is used (Figs. 6.6, 6.7). Utmost care should be taken to make sure that the other irrigation port is unlocked to allow the irrigation fluid to drain off and prevent the risk of a dangerous rise in intracranial pressure. The author advocates the use of lactated Ringer's solution at 36–37 °C because postoperative increases in body temperature or hyperventilation, as occasionally seen after abundant irrigation with saline, are rarely encountered.
Minor hemorrhage usually ceases spontaneously after a few minutes of irrigation. Additionally, the bipolar diathermy probe can be used for hemostasis. When faced with severe hemorrhage resulting in a completely obscured vision, the endoscope must not be moved. It should be kept in place and forced irrigation should be initiated. Once some degree of vision has been restored, the endoscope is slowly advanced to the bleeding vessel. The endoscope is withdrawn into the sheath and the tip of the sheath should be positioned as close as possible to the bleeding vessel. The space in front of the lens within the sheath can easily be irrigated until vision is cleared. Thereafter, the bipolar diathermy probe is repositioned exactly at the bleeding vessel. Gentle pressure is applied to compress the vessel and stop the hemorrhage temporarily. Next, continuous irrigation is used to clear the field and to identify the anatomy. The bleeding vessel is coagulated until final hemostasis is achieved.12

In exceedingly rare cases of severe hemorrhage, aspiration of CSF is needed to obtain a dry field. With this ‘Dry Field’ Technique, bleeding vessels are more easily identified and hemostasis is quickly achieved.16

However, prevention of hemorrhage is better than its treatment. Therefore, larger vessels that are particularly susceptible to iatrogenic injury during endoscopic dissection should be cauterized with a bipolar diathermy probe before bleeding occurs.

At the end of the procedure, the ventricles are inspected to make sure that there is no active hemorrhage. The endoscopic sheath is withdrawn simultaneously with the endoscope to look for active bleeding in the cortical puncture channel. Usually, no external ventricular drainage is placed. The burr hole is packed with a gelatine sponge (Fig. 6.8). For cosmetic reasons, the burr hole is sometimes covered with a titanium burr hole plate (Fig. 6.9). The galea is sutured tightly to prevent subgaleal CSF accumulation and fistula formation. The skin is closed with running atraumatic suture. The patient is observed overnight at the intermediate care unit.

Any CSF pathway obstruction leading to an occlusive hydrocephalus is a good indication for endoscopic treatment including monoventricular hydrocephalus due to obstruction of one foramen of Monro, biventricular hydrocephalus due to bilateral obstruction of the foramina of Monro, triventricular hydrocephalus due to aqueductal obstruction or tetraventricular hydrocephalus due to obstruction of the fourth ventricular outlets (foramina Magendi and Luschkae).32 A rare, but good indication for endoscopic treatment is the intracisternal blockage of CSF circulation due to membranes around the brain stem, the so-called extraventricular intracisternal obstructive hydrocephalus. Additionally, any kind of trapped ventricles can be approached endoscopically, such as trapped fourth ventricle frequently seen after shunt placement in newborns, trapped temporal horns or multiloculated hydrocephalus. Furthermore, intraventricular lesions such as colloid or pineal cysts as well as tumors can be resected endoscopically. Large cystic lesions like arachnoid and intraparenchymal cysts can be fenestrated to create a communication to the normal CSF pathways. Another application area of the ventriculoscope is endoscopic lavage in cases of ventriculitis and intraventricular hemorrhage and is aimed at removing infectious material and blood from the ventricles.
8.1 Septum Pellucidum Fenestration

Fenestration of the septum pellucidum is indicated in monoventricular hydrocephalus caused by obstruction of one foramen of Monro leading to dilation of the ipsilateral lateral ventricle or when the obstruction is proximal to the foramen within the middle part of the ventricle. The surgeon must make sure that patency of the contralateral foramen of Monro is confirmed. The patient is positioned supine with the head flexed 30° in a straight position. The entry point is located approximately 5–6 cm paramedian on the side of the dilated ventricle in front of the coronal suture (Fig. 8.1a). Navigation is helpful in identifying the ideal entry point and approach trajectory. Once the septum has been inspected, the optimal area for the fenestration is selected. There is no specific area where the fenestration has to be made. The decision should be based on individual anatomical circumstances. In chronic hydrocephalus, the septum is usually thin and an avascular part of the septum suited for fenestration is easily found. In acute patients, the septum is usually thick and not translucent. Intermittent forced irrigation helps in identifying the thinnest part of the septum which is highly flexible. Care should be taken to avoid damage to the fornices. Vessels located in the area of the intended fenestration are cauterized with bipolar diathermy and cut. The area to be fenestrated is coagulated in a circumferential manner (Fig. 8.1b). The resulting tissue bridges are cut with scissors except for one that should be left intact (Fig. 8.1c) serving as a pedicle to prevent the flap from dropping into the ventricle. Using a grasping forceps, the flap is finally removed (Fig. 8.1d). The margins of the fenestration are coagulated. The fenestration size should measure between 7 and 10 mm in diameter (Fig. 8.1e) to prevent closure of the fenestration by scarring which might pose a problem especially in thick septa.18,31

Fig. 8.1 Endoscope trajectory for septostomy (a). Circular coagulation of the septum (b). Cutting of the septum with scissors (c). Removal of the septal flap with a grasping forceps (d). Septostomy upon completion (e).
Case Presentation

6 – Septostomy with the LOTTA® Ventriculoscope
Click here or see page 5.

Fig. 8.2 The 47-year-old male patient presented with a right thalamic pilocytic astrocytoma.

Fig. 8.3 The tumor was totally resected via a transventricular approach.

Fig. 8.4 One month after surgery, the patient was admitted with a severely aggravating gait disorder, headaches, and fine motor disturbances. MR imaging showed a huge increase in the size of the right temporal and occipital horn and the posterior areas of the cella media.

Fig. 8.5 Navigation was used to determine the ideal entry point and approach trajectory.

Fig. 8.6 Navigation was used to help in localizing the fenestration site.
After inserting the endoscope, the dilated cavity is inspected. The only landmark are the internal cerebral veins (a). Under navigational guidance, the ideal area for fenestration is identified. Intermittent forced irrigation helps in identifying the thinnest part of the septum (b). The septum is perforated with the bipolar diathermy probe (c, d). The 2-mm/30°-diagnostic scope is inserted via the fenestration to check the contralateral cavity – recognizable by the choroid plexus (P) – and to make sure that the contralateral ventricle has been reached (e). With the bipolar probe, the septostomy area is circumferentially coagulated (f).

The septostomy is created by circumferential coagulation with the bipolar probe (a). Next, the resulting tissue bridges are cut with scissors except for one that should be left intact to prevent the flap from dropping into the ventricle (b). Using a grasping forceps, the flap is removed en bloc (c). Finally, the fenestration margins are coagulated (d). The 3.3-mm/30°-diagnostic scope is used to inspect the contralateral ventricle showing the choroid plexus and choroidal vein (e). Upon final inspection, the septostomy is confirmed to be wide open (f).
Fig. 8.9 The patient’s symptoms resolved soon after surgery. The postoperative MR images clearly demonstrate a decrease in ventricular size and the septostomy to be wide open (d, ➔).

8.2 Temporal Ventriculostomy

Temporal ventriculostomy is indicated in trapped temporal horns occurring after tumor resection, hemorrhage, or ventriculitis.\(^{10,32}\) The procedure may be adopted when fenestration into the lateral ventricle is not a feasible option because of scarring or anatomical variations in that region. Temporal ventriculostomy should only be attempted if the interpeduncular cistern is sufficiently wide and the temporomesial wall is thinned out. The head is turned to the contralateral side. The ideal entry point is determined with the aid of neuronavigation. Usually, the burr hole is placed in the temporoparietal region to allow a straight access to the tip of the temporal horn (Fig. 8.10).

Once the endoscope has been inserted into the temporal horn under navigational guidance, the choroid plexus as the main landmark is identified and followed to the tip of the temporal horn. Occasionally, the head of the hippocampus is visualized. At the tip of the temporal horn, the mesial wall near the choroidal fissure is usually thin. The ideal area for performing the fenestration is the mesial wall adjacent to the interpeduncular cistern. Jet irrigation is helpful in identifying the thinnest area of the mesial wall. The initial perforation is performed bluntly using the Decq forceps with jaws closed. A 2-mm diagnostic scope is inserted through the initial fenestration to make sure that the cistern has been reached. Then, the fenestration is enlarged with the aid of a 3-French balloon catheter. Apart from that, brain tissue at the fenestration margin is resected with the grasping forceps to enlarge the opening and thus prevent re-closure by scarring. Utmost care must be taken to avoid damage to the oculomotor nerve and the perforating arteries of the posterior communicating and posterior cerebral arteries. The final inspection of the interpeduncular cistern shows the oculomotor nerve and pituitary stalk.

Fig. 8.10 Endoscope trajectory for temporal ventriculostomy.
Case Presentation

7 – Temporal Ventriculostomy with the LOTTA® Ventriculoscope – Click here or see page 5.

Key to Acronyms

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<tr>
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<th>Description</th>
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<tr>
<td>H</td>
<td>hippocampus</td>
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<tr>
<td>OC</td>
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<td>Pca</td>
<td>posterior cerebral artery</td>
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<td>Ps</td>
<td>pituitary stalk</td>
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<tr>
<td>Sca</td>
<td>superior cerebellar artery</td>
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Fig. 8.11 The 15-year-old female presented with asymptomatic but progressive dilation of the temporal horn after tumor resection in the trigone area.

Fig. 8.12 Once the scope has been inserted, the tip of the dilated and trapped temporal horn is inspected showing the head of the hippocampus (a). The thinnest area of the mesial wall is approached and the trajectory confirmed with navigation (b). The mesial wall is bluntly perforated with a Decq forceps (c). Opening the jaws of the forceps, the perforation is enlarged (d). View obtained through the 2-mm / 30° scope showing the oculomotor nerve and posterior cerebral artery. The presence of these landmarks confirms that the interpeduncular cistern has been reached (e). Brain tissue at the margin of the fenestration is resected with the biopsy forceps (f).

Fig. 8.13 The fenestration is enlarged by inflating the balloon of a 3-French catheter (a). Inspection of the interpeduncular cistern with the 3.3-mm / 30° diagnostic scope reveals the pituitary stalk (b). Using the same scope to further investigate the interpeduncular cistern exhibits the oculomotor nerve, posterior cerebral artery, and superior cerebellar artery (c). Large ventriculostomy as seen in final stage of the procedure (d). MR images taken 1 year after surgery show a decrease in the size of the temporal horn and confirm patency of the ventriculostomy (e, f).
8.3 Foraminoplasty

Foraminoplasty of the foramen of Monro is indicated when both foramina of Monro are occluded and dilation of both lateral ventricles is present.\textsuperscript{7,31} Foraminoplasty should always be performed on one side only. This is important because foraminoplasty bears the potential risk of damage to the fornix or hypothalamus. Usually, the non-dominant side is selected. However, if the coronal MR image shows that the stenosis is less severe or shorter on the dominant side, the latter is selected because the risk of fornicial or hypothalamic injury is lower. Once restoration of patency of one foramen is complete, a septostomy is performed to create a communication between both lateral ventricles. Septostomy is associated with less risks and has a high long-term patency rate. If the septum pellucidum is already fenestrated due to a long-standing hydrocephalus, unilateral foraminoplasty is sufficient to restore CSF circulation. The entry point is usually located about 2 to 3 cm paramedian on the right side, 2 – 3 cm in front of the coronal suture (Fig. 8.14). Neuronavigation is not required. The area of the foramen is easily found when following the choroid plexus, which runs from the lateral ventricle through the foramen of Monro into the third ventricle under the fornix (Fig. 8.15a). In front of the plexus, the fornix is identified. Occasionally, a hypertrophic choroid plexus is found to simply obstruct the foramen. In these cases, coagulation and shrinking of the plexus is all that is required. If the foramen is truly occluded or stenotic, careful enlargement of the foramen with the aid of a balloon catheter is performed (Fig. 8.15b). Care must be taken to avoid undue stretching of the fornix.

If the foramen is occluded by a thin membrane, a simple membrane perforation is sufficient. However, when the foramen is still narrow after having performed the foraminoplasty and the risk of recurrent occlusion is expected to be high, a stent should be inserted via the foramen from the lateral to the third or even fourth ventricle. The length of the stent is determined according to measurements obtained by sagittal MR images. In order to prevent the risk of stent migration, the stent should be connected to a burr hole reservoir (Fig. 8.15d).
Case Presentation

Foraminoplasty with the LOTTA® Ventriculoscope – Click here or see page 5.

**Fig. 8.16** The 32-year-old female presented with recurrent headaches 30 months after endoscopic third ventriculostomy for treatment of occlusive hydrocephalus due to aqueductal stenosis. MR imaging showed dilation of both lateral ventricles with a collapsed third ventricle caused by bilateral stenosis of the foramina of Monro. The third ventriculostomy is wide open (c, ➔).

**Fig. 8.17** The septum pellucidum is atrophic and perforated due to long-standing hydrocephalus (a). The left foramen of Monro is covered by choroid plexus (b). Plexus coagulation with bipolar diathermy (c). Following coagulation of the choroid plexus, the narrow foramen of Monro is visible (d). Careful dilation of the foramen of Monro with the aid of a catheter (e). Restored foramen (f). Stent inserted into the third ventricle (g).

**Fig. 8.18** MR images taken 2 years after surgery show a decrease in the size of the lateral ventricles and confirm that the stent is in proper position.
8.4 Third Ventriculostomy

Third ventriculostomy is indicated in obstructive hydrocephalus in cases where the obstruction is located distally to the floor of the third ventricle, i.e., intraventricular lesions located in the posterior third ventricle, aqueduct or fourth ventricle, aqueductal stenosis, and fourth ventricular outlet obstructions. Apart from these conditions, CSF pathway obstructions within the prepontine cistern, the so-called extraventricular intracisternal obstructive hydrocephalus with bulging of the floor of the third ventricle into the interpeduncular cistern – even though the aqueduct is open – are a good indication for third ventriculostomy. Additionally, endoscopic third ventriculostomy is a worthwhile alternative option in the treatment of patients with shunt malfunction when MR imaging shows an obstructive component of the hydrocephalus. According to our experience, third ventriculostomy has shown to be ineffective in the treatment of communicating hydrocephalus including normal pressure hydrocephalus.

Prior to surgery, CT or MR images are investigated in order to be aware of the individual relationship between the basilar artery and the floor of the third ventricle. In general, the operating sheath is inserted free-hand into the right lateral ventricle via a right precoronal burr hole (2.5 cm paramedian) (Fig. 8.19). Once the endoscope has been passed through the foramen of Monro into the third ventricle, the floor with mamillary bodies and infundibular recess can be identified (Fig. 8.20a). The ideal fenestration site is selected according to the individual anatomy of the floor. The correct placement of the fenestration in the floor of the third ventricle is of utmost importance to avoid vascular and neural damage. Usually, the perforation of the floor is made just behind the clivus, halfway between the infundibular recess and mamillary bodies in the midline. In order to prevent perforator injury, the fenestration should always be made in front of the basilar artery, even in cases when the latter is located more anteriorly than usually found (Fig. 8.20b).

Usually, the floor is bluntly perforated using a rigid instrument (e.g., a bipolar probe) without application of energy or by use of a biopsy forceps with jaws closed. We prefer using the Decq forceps which allows a precise and atraumatic perforation (Fig. 8.20c).

![Fig. 8.19 Entry point and trajectory of the endoscope for third ventriculostomy.](image)

![Fig. 8.20 Floor of the third ventricle with mamillary bodies (M), basilar tip (B), infundibular recess (I), and optic chiasm (O) (a). Fenestration site (b). Perforation of the floor with a Decq forceps (c).](image)
Perforation with the balloon catheter itself should be avoided since with firm floors the catheter may slip to one side or the other, perforating the floor in a less than ideal place and increasing the risk of neurovascular injury. Given a thick or dense floor, blunt perforation undertaken in a probing manner readily reveals whether the intended maneuver will exert undue traction on the floor and adjacent hypothalamus. In this case, an initial perforation is made with the aid of the bipolar probe at low energy (10 watts) or, although in our experience only rarely required, with scissors. Thereafter, the initial fenestration is enlarged by inflating the balloon of a 3-French catheter to achieve an adequate fenestration size of 3 to 6 mm in diameter (Fig. 8.21a). The balloon should be prefilled with saline instead of air to avoid a ‘pop-up’ effect and to achieve a slow and incremental inflation.

The interpeduncular and pontine cisterns are inspected through the ventriculostomy (Fig. 8.21b, c). In the presence of a Liliequist's membrane, it is also fenestrated. Additionally, any other arachnoid membranes further down the clivus, which may interfere with CSF circulation, have to be fenestrated to enable a good pulsatile CSF flow.

Case Presentation

Fig. 8.21 Enlargement of the ventriculostomy with a catheter (a). Properly placed ventriculostomy (b). Insertion of the endoscope through the ventriculostomy into the prepontine cistern (c).

Fig. 8.22 The 43-year-old male presented with headache, gait disturbances, and decreased performance. MR imaging showed a chronic hydrocephalus caused by aqueductal stenosis and downward bulging of the floor of the third ventricle. The aqueduct shows typical prestenotic dilation (d,UTION). Note the absence of a flow-void sign in the aqueductal lumen.
Foramen of Monro with fornix, choroid plexus, septal vein and thalamostriate vein (a). Translucent floor of the third ventricle with mamillary bodies, basilar artery, and clivus (b). Perforated septum (c). The 45° diagnostic scope shows the mamillary bodies and prestenotic dilation of the aqueduct (d). Perforation of the floor with the Decq forceps (e). Enlargement of the fenestration with a balloon catheter (f). Inspection of the prepontine cistern through the ventriculostomy shows an arachnoid membrane blocking CSF flow (g). Perforation of the membrane with the Decq forceps (h).

Fig. 8.24 Cutting of the membrane with scissors. The sheath of the Little LOTTA® ventriculoscope is advanced through the ventriculostomy and protects the basilar artery (a). The wide fenestration of the prepontine arachnoid membrane allows a good pulsatile CSF flow through the ventriculostomy (b). Completion of the ventriculostomy just behind the clivus (c).

Fig. 8.25 MR imaging taken 5 months after surgery. There is a noticeable decrease in ventricular size, a wide open ventriculostomy (arrow) and a marked flow-void sign confirming patency of the ventriculostomy. The patient’s symptoms resolved almost completely.
Case Presentation

10 – Third Ventriculostomy with the Little LOTTA® Ventriculoscope – Click here or see page 5.

Fig. 8.26 The 17-year-old female presented with persistent headache. MR imaging showed a chronic triventricular hydrocephalus caused by a tectal glioma (➞) leading to aqueductal obstruction. The floor of the third ventricle is bulging downwards. The pituitary stalk is severely distorted. The ventricles are wide.

Fig. 8.27 Foramen of Monro with fornix, choroid plexus, septal vein, caudate veins, and thalamostriate vein. In the depth, the mamillary bodies are already seen (a). Translucent floor of third ventricle with mamillary bodies, P1 segments of the posterior cerebral arteries, infundibular recess, and thin tuber cinerium (b). Perforation of the floor with the Decq forceps (c). Enlargement of the fenestration with a balloon catheter (d). Inspection of the prepontine cistern through the ventriculostomy with the 30° diagnostic scope shows the basilar artery (e). View of the ventriculostomy accurately placed just behind the clivus (f). Upon completion of the ventriculostomy, integrity of the foramen of Monro confirms the correct trajectory of the approach (g).

Fig. 8.28 MR images taken 3 months after surgery demonstrate that the ventriculostomy is wide open. Note the flow-void sign (➞) and obvious decrease in ventricular size. The distortion of the pituitary stalk has been resolved. The patient is doing fine with no complaints.
8.5 Aqueductoplasty and Stenting

Aqueductoplasty is an alternative treatment option in membranous aqueductal stenosis. However, because of the high re-closure rate of 88% in our series, we have abandoned aqueductoplasty for aqueductal stenosis. The only indication for aqueductoplasty in our center is trapped fourth ventricle, however, this should be combined with aqueductal stenting in order to prevent reclosure of the aqueduct. For cosmetic reasons, the burr hole is usually placed just behind the hairline which involves that the burr hole is about 6 cm anterior to the coronal suture and about 2 cm lateral from the midline (Fig. 8.29a). Neuronavigation has shown to be helpful in patients with small ventricles and a narrow foramen of Monro. Retrograde aqueductoplasty and stenting via the dilated fourth ventricle is indicated when the aqueductal area is not accessible via the lateral ventricles (Fig. 8.29b). This is usually found in overdrained shunted patients in whom the third ventricle is shaped like a slit and the foramina of Monro are almost closed. Neuronavigation is mandatory in finding the ideal entry point which is usually located 1 to 2 cm lateral from the midline. Because the anatomy in the region of the aqueduct is often distorted, neuronavigation is also valuable in defining the proper position for aqueductoplasty and stenting.

A 3-French balloon catheter is usually gently passed through the stenosis (Fig. 8.29c). Preoperative planning and evaluation of MR images is of utmost importance in order to clarify the individual anatomy of the aqueduct. If the aqueduct assumes a curved shape, the tip of the catheter should be bent to avoid perforation of the tectal plate. The balloon is either in a fully deflated state or inflated only slightly to create an aqueductal opening that allows passage of the ventricular catheter (stent). Having perforated the aqueductal stenosis, the 0°- and 30°-diagnostic scopes (diameter 2 mm) can be used to inspect the aqueduct and fourth ventricle in order to make sure that the cavity of the fourth ventricle has been entered. Next, the stent is inserted into the aqueduct via the main working channel of the LOTTA® ventriculoscope. The length of the stent is determined preoperatively based on sagittal MR images. The stent should have multiple side holes, but not at the level of the aqueduct in order to prevent ependymal ingrowth. The stent is fixed to a burr hole reservoir to prevent stent migration (Figs. 8.29d–e). This allows to quickly obtain CSF samples and facilitates stent removal in case of stent infection. Although aqueductal stenting is an alternative treatment option to third ventriculostomy in non-neoplastic and neoplastic aqueductal stenosis, the author prefers a third ventriculostomy approach because it eliminates the need for using any foreign material which carries the risk of infection and malfunction.
Case Presentation

11 – Aqueductal Stenting with the LOTTA® Ventriculoscope – Click here or see page 5.

Fig. 8.30 The 1-year-old boy, a premature newborn, presented with posthemorrhagic hydrocephalus. At the age of 3 months, soon after VP shunting, the patient developed a slowly progressive dilation of the fourth ventricle. MR imaging showed a trapped fourth ventricle and compression of the brain stem against the clivus (a). Note the absence of a flow-void sign within the aqueduct (b). Cyclops ventricle with fornix, corpus callosum, foramen of Monro (➞) and aplasia of the septum pellucidum (c). Occluded aqueduct above the posterior commissure with hemosiderin deposits (d). Aqueductoplasty with catheter (e). View of the restored aqueduct (f). Fourth ventricle seen through the 30°-diagnostic scope (diameter 2 mm) (g). Stent inserted via the aqueduct into the fourth ventricle (h).

Fig. 8.31 Removal of the endoscopic sheath under visualization of the stent (a). The stent is secured at the burr hole with a forceps (b). Final inspection along the stent using a 0°-diagnostic scope (diam. 2 mm) to make sure that the stent is in proper position (c). MR images (d–g) taken 3 years after surgery confirm a correct position of the stent. The size of the fourth ventricle is normalized. Brain stem compression completely resolved. Apart from minor symptoms of psychomotor retardation, the follow-up examination showed a good neurological development of the young patient.

Key to Acronyms

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<tr>
<th>Acronym</th>
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<td>CC</td>
<td>corpus callosum</td>
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<td>F</td>
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<td>pC</td>
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8.6 Choroid Plexus Coagulation with the LOTTA® Ventriculoscope

Choroid plexus coagulation can be considered in patients where CSF is poorly resorbed or excessively produced, such as in hypertrophic choroid plexus. Usually, flexible scopes are used because most patients are newborns or infants and both ventricles can be reached via one burr hole. However, the coagulation electrodes used in flexible scopes are very thin and only moderately effective. Because of the large working channel of the LOTTA ventriculoscope, very effective bipolar forceps or bipolar coagulation electrodes (Fig. 2.18) can be used.

The patient is positioned prone with the head in straight position. The entry point is selected in the temporo-occipital region at a paramedian distance of 2.5 cm, allowing access to the trigone from where both the temporal and frontal horn of the lateral ventricle can be approached (Fig. 8.32). The burr holes are placed bilaterally. In this way, the entire choroid plexus of the lateral ventricle can be coagulated using a rigid HOPKINS® rod-lens scope. The plexus needs to be coagulated thoroughly to avoid later regeneration. Depending on the extent of the choroid plexus hypertrophy, the intended obliteration may need some time to become effective.

Case Presentation

Fig. 8.33 The 3-year-old female had been shunted because of hemorrhagic hydrocephalus soon after birth. Although the shunt was working properly, she presented with massive ascites. Alternative shunt surgeries (VA shunt etc.) were not successful. T1-weighted contrast-enhanced MR imaging showed a hypertrophic choroid plexus (arrows) within both lateral ventricles.

Fig. 8.34 Navigation-guided insertion of the endoscope.
Fig. 8.35  Choroid plexus (P) within the trigone (a). Hypertrophic choroid plexus (P) within the temporal horn (b). On close-up view, the distinct hypertrophy of the choroid plexus (P) is demonstrated (c). Coagulation of the choroid plexus with a bipolar coagulation electrode (d) and with a bipolar forceps (e). While proceeding with coagulation, the plexus turns pale (f). Final aspect of the coagulated plexus within the temporal horn (g) and within the trigone (h).

Fig. 8.36  MR imaging obtained 1 year after surgery demonstrated a normal appearance of the choroid plexus and a decreased size of the ventricles. The ascites resolved as early as 2 days after surgery and has not recurred since then.
Intraventricular tumors are a frequent cause of obstructive hydrocephalus. Therefore, the two surgical objectives are to restore the CSF pathways and to yield a suitable specimen for histological examination. Endoscopy is an ideal modality to achieve these goals. Apart from that, the endoscopic approach is also an option in the treatment of intraventricular tumors with non-dilated ventricles. Furthermore, it allows a total extirpation of small tumors. The endoscope should be inserted into the ventricle via a trajectory offering the best working space in front of the lesion, which may not always be the shortest approach.

In tumors of the third ventricle/pineal area, third ventriculostomy is often combined with tumor biopsy. If the foramen of Monro is of adequate size, both procedures can be performed via one burr hole which is located approximately 3 cm in front of the coronal suture. A gentle tilt of the endoscope should suffice to give access to the floor of the third ventricle and the tumor. However, in case of a small foramen, only one target area (floor or tumor) is accessible with a rigid endoscope. If only rigid scopes are available, two burr holes need to be placed to perform ventriculostomy and tumor biopsy. Based on our experience, this is required only in rare instances. In most patients, one burr hole is sufficient.

Fig. 9.1 Endoscope trajectories for trigone tumor (a) and for ventriculostomy combined with biopsy sampling via a single burr hole (b). Endoscope trajectory for ventriculostomy (c). Endoscope trajectory for tumor biopsy (d).
Case Presentation

Fig. 9.2 The 24-year-old male presented with severe deterioration of visual acuity and visual field. Endocrinological examination revealed a pan-pituitary insufficiency. MR imaging (a–c) showed a contrast-enhancing intra- and suprasellar lesion with infiltration of the optic nerves and chiasm. Due to narrow ventricles, the endoscopic sheath was advanced to the target site under navigational guidance (d). Small foramen of Monro (e). Tumor (Tm) at the floor of the third ventricle (f). Tumor biopsy with a biopsy forceps (g). Minor hemorrhage was controlled by irrigation (h).

Fig. 9.3 Bipolar coagulation of a bleeding vessel (a). Surgical field after hemostasis (b). Intact foramen after biopsy sampling (c).

Fig. 9.4 Histological examination revealed a germinoma. Oncological treatment was initiated. The follow-up MR images obtained 3 months after biopsy and secondary to radiation and chemotherapy demonstrated a complete disappearance of the lesion. Visual acuity and visual field improved. The pan-pituitary insufficiency persisted.
Case Presentation

14 – Third Ventriculostomy and Tumor Biopsy with the Little LOTTA® Ventriculoscope — Click here or see page 5.

**Fig. 9.5** The 11-year-old girl presented with headache, vomiting, and balance problems. MR imaging showed a cerebellar lesion with obstructive hydrocephalus (a–c). Inspection with a 30° diagnostic scope shows the optic chiasm (O) and intraventricular tumor (Tm) dissemination (d). Third ventriculostomy (e). Inspection of the prepontine cistern with a 30° diagnostic scope reveals intracisternal tumor dissemination (arrows) (f). Tumor biopsy with a biopsy forceps (g).

15 – Third Ventriculostomy and Tumor Biopsy of Pineal Lesion with the LOTTA® Ventriculoscope — Click here or see page 5.

**Fig. 9.6** The symptoms of increased intracranial pressure disappeared immediately after ventriculostomy. Histological examination revealed a medulloblastoma. MR imaging obtained 2 days after microsurgical tumor resection shows the decrease in ventricular size and the flow void sign through the ventriculostoma.

15 – Third Ventriculostomy and Tumor Biopsy of Pineal Lesion with the LOTTA® Ventriculoscope — Click here or see page 5.

**Fig. 9.7** The 70-year-old female presented with significant memory loss and psychomotor deceleration. MR imaging showed an enhancing pineal lesion with obstructive hydrocephalus.
Fig. 9.8 Foramen of Monro (a). Perforation of the floor with a Decq forceps (b). The stoma is enlarged using a balloon catheter (c). Ventriculostomy (d). Inspection of the preptontine cistern with a 30° diagnostic scope (e). The scope is tilted with care in a dorsal direction to reach the pineal region (f). Visualization of the tumor (Tm) (30° diagnostic scope) (g). Tumor biopsy with biopsy forceps. Note that the scope has been rotated 180°. The working channel is now at 6 o’clock, conferring the advantage of accessing the tumor with less tilting of the scope (h). Foramen of Monro at the end of the procedure (i).

Note, that neither the fornix nor the veins show any signs of injury, even though the scope was tilted to reach the floor and the tumor (i).

Fig. 9.9 The histological examination revealed a pineal parenchymal tumor of intermediate differentiation. Radiation was initiated 5 weeks after biopsy (a). MR imaging obtained 3 months after surgery and radiation therapy shows the decrease in ventricular and tumor size and a weak flow-void sign through the ventriculostoma (b, c). The symptoms markedly improved.
Case Presentation

16 – Extirpation of Recurrent Intraventricular Craniopharyngeoma with the LOTTA® Ventriculoscope — Click here or see page 5.

Fig. 9.10 The 44-year-old male presented with an asymptomatic recurrent craniopharyngeoma 2 years after resection of an infiltrating huge craniopharyngeoma (a). MR imaging showed a cystic lesion located in the left lateral ventricle at the foramen of Monro (b). Because of narrow ventricles, the endoscopic sheath was inserted under navigational guidance (c).

Fig. 9.11 Cystic lesion (a). Coagulation of the cyst wall (b). Perforation of the cyst wall with a Decq forceps (c). Aspiration of cyst content with a small endotracheal suction tube (d). Bimanual dissection with flexible forceps and scissors (e). Cutting of the choroid plexus, which is attached to the tumor (f). Removal of tumor tissue with biopsy forceps (g). Tumor bed within the septum pellucidum after total tumor resection (h).

Fig. 9.12 MR imaging obtained 3 months (a, b) after surgery showed the gross total tumor resection. The patient was doing fine at the time of the visit. The MR images obtained at 3-year follow-up (c, d) showed no signs of recurrence. The patient is still doing fine.
Case Presentation

17 – Extirpation of Intraventricular Subependymoma with the LOTTA® Ventriculoscope – Click here or see page 5.

Fig. 9.13 The 70-year-old male was a volunteer in a MR imaging study. MR imaging showed a slightly enhancing lesion within the left frontal horn as an incidental finding. Because of tumor progression 2 years after the first MR imaging, surgery was indicated (a–d). Due to narrow ventricles, the endoscopic approach was planned with the aid of neuronavigation (e). Insertion of the endoscopic sheath under navigational guidance (f).

Key to Acronyms

- C choroidal vein
- CN caudate nucleus
- F fornix
- P choroid plexus
- Sv septal vein
- T thalamostriate vein

Fig. 9.14 Visualization of dorsal (a) and ventral (b) aspects of the lesion. Resection with grasping forceps (c–d). Identification of the tumor pedicle (➞) (e). Detachment of the tumor from the head of the caudate nucleus with a bipolar electrode. Note, that the endoscopic sheath is used to retract the head of the caudate nucleus to facilitate access to the tumor pedicle (f). Due to the size of the tumor being too large for the endoscopic sheath, removal was accomplished via the cortical puncture channel by retracting both the scope and its sheath together with the tumor (g). Extirpated tumor (h). Inspection after tumor removal confirms integrity of the foramen of Monro, with fornix, choroid plexus and septal vein and shows the tumor bed at the head of the caudate nucleus after total tumor resection (i).
Case Presentation

18 – Resection of Hypothalamic Hamartoma with the Little LOTTA® Ventriculoscope – Click here or see page 5.

Fig. 9.15  MR imaging obtained one day after surgery shows the gross total tumor resection. The patient is doing fine and has no memory deficits. MR imaging taken 3 years after surgery, showed no signs of recurrence.

Fig. 9.16  The 33-year-old male suffered from frequent gelastic seizures and rage attacks which were resistant to medical therapy. MR imaging showed a hypothalamic hamartoma (arrows) within the third ventricle. The ventricles were small.

Fig. 9.17  The use of a neuro-navigation system is imperative in accurate planning of the approach because of the very small ventricles and narrow foramen of Monro. Since the hamartoma is located in the left hypothalamus, an approach from the right side is taken.

Fig. 9.18a–h  Small foramen of Monro with septal vein (SV), fornix (F), choroid plexus (P), and atypical course of the thalamostriate vein (TV) causing severe foraminal stenosis (a). Foraminoplasty with Fogarty balloon catheter (b). Reopened foramen of Monro (c). The endoscopic sheath is inserted into the third ventricle with the aid of the optical trocar. The hamartoma (H) is already visible (d). The hamartoma (H) is localized at the left wall of the third ventricle (e). View of the anterior third ventricle with the 30°-diagnostic scope showing the chiasm (C), infundibular recess (I), and the hamartoma (H) (f). Biopsy sampling from the hamartoma is performed with biopsy forceps (g). Progressive detachment of the hamartoma from the hypothalamus (h).
Fig. 9.18i–o  The endoscope sheath is used as a retractor to separate the hamartoma from the ventricular wall (i). The posterior margin of the hamartoma (→) is localized (j). Detachment of the hamartoma (k). Removal of the hamartoma is accomplished by withdrawing the scope through its sheath (l). View of the resected hamartoma following extraction (m). Floor of the third ventricle after resection of the hamartoma (n). Final aspect of the intact foramen at completion of surgery (o).

Fig. 9.19  MR imaging obtained 2 days after surgery confirmed the near total resection of the hamartoma. The patient’s condition improved dramatically with a markedly reduced rate of seizures and resolution of rage attacks.
Colloid Cysts

Colloid cysts usually arise from the tela choroidea at the roof of the third ventricle. Once the cysts have grown to a certain size, they cause obstruction of one or both foramina of Monro, resulting in hydrocephalus. This ventricular dilation gives excellent conditions for an endoscopic approach. Even though colloid cysts in small ventricles may also be approached endoscopically – given slit-like ventricles with cysts being located more posteriorly – we prefer a microsurgical transcallosal approach. The major objective of colloid cyst resection is usually a total cyst removal. If the cyst content is not amenable to suction removal and endoscopic surgery proves ineffective, we resort to a microsurgical technique performed via the same transcortical approach. In our series of endoscopic colloid cyst resections, this was required in one patient only.

Usually, the best trajectory by which a colloid cyst can be approached, is a burr hole placed at a far anterolateral site, providing an optimal visualization of the attachment area at the roof of the third ventricle. The endoscope is just gently advanced over the head of the caudate nucleus (Fig. 10.1a). The author routinely uses neuronavigation to pinpoint the ideal entry site. In general, the standard precoronal burr hole should not be used, because it only offers a tangential view of the cyst surface and does not afford a view of the roof of the third ventricle where the cyst is attached. The only exception is a cavum septi pellucidi or cavum vergae which allows an approach through the septal space. These cysts are approached from the top by traversing between the fornices (Fig. 10.1b).

Fig. 10.1 Endoscope trajectory for a colloid cyst (a). Endoscope trajectory for a colloid cyst with a septal cavity (b).
Frequently, a colloid cyst is covered by choroid plexus which is cauterized (Figs. 10.2a, b). Thereafter, the cyst wall is incised (Fig. 10.2c). The cyst content is aspirated using a pediatric endotracheal suction tube (Fig. 10.2d). Subsequently, the cyst is mobilized into the lateral ventricle with a grasping forceps (Fig. 10.2e). Employing a bimanual technique, the cyst’s pedicle at the tela choroidea is coagulated and cut (Figs. 10.2f, g). Finally, the cyst is removed, followed by inspection of both the foramen and the third ventricle (Fig. 10.2h).

Fig. 10.2 Colloid cyst covered by choroid plexus (a). Coagulation of the choroid plexus with a bipolar electrode (b). Incision of the cyst wall (c). Aspiration of the cyst content with a suction tube (d). Mobilization of the cyst into the lateral ventricle (e). Coagulation of the pedicle with a bipolar electrode (f). Cutting of the pedicle with scissors (g). Final aspect of the foramen after cyst removal (h).
Case Presentation

19 – Colloid Cyst Resection with the LOTTA® Ventriculoscope – Click here or see page 5.

Fig. 10.3 The 22-year-old male student presented with increasing headache, pressure feeling in the head, and vomiting. MR imaging showed a colloid cyst (➞) with obstruction of both foramina of Monro and dilation of both lateral ventricles (a–c). Neuronavigational planning of the ideal approach (d).

Fig. 10.4 Choroid plexus covering the cyst (a). Coagulation of the choroid plexus (b). Opening of the cyst wall with scissors (c). Evacuation of the cyst content with a suction tube (d). The cyst is mobilized into the lateral ventricle with a grasping forceps (e). The cyst is picked up with a flexible forceps to get access to the pedicle (f). Coagulation of the pedicle (g). Cutting of the pedicle (h). En-bloc removal of the cyst (i). Extirpated cyst (j).

A 45° diagnostic scope is used to inspect the tela choroidea (Te) and choroid plexus (P) at the roof of the third ventricle as well as the fornix (F) of the contralateral foramen of Monro (➞) and to confirm total cyst removal (k). Final inspection of the foramen of Monro shows that integrity of veins and fornix has been preserved (l).
Case Presentation

Fig. 10.5 MR imaging obtained five years after surgery confirms the absence of any cyst remnant. The ventricles decreased markedly in size. The patient is free of symptoms.

Fig. 10.6 The 18-year-old male underwent partial endoscopic cyst resection, performed 3 years earlier at another institution. The follow-up MR imaging revealed an enlargement of the residual cyst. Therefore, a second attempt to resect the cyst endoscopically was indicated. MR imaging showed a large cyst occluding both foramina of Monro (➞). The patient is still asymptomatic.

Fig. 10.7 Colloid cyst covered by choroid plexus (a). Coagulation of the choroid plexus (b). Opening of the cyst wall with scissors (c). Evacuation of the cyst content with a suction tube (d). Evacuated cyst (e). The cyst is attached to unusual vessels (arrows) arising from the lower margin of the foramen of Monro which require sharp dissection (f). Coagulation of the atypical vessels (➞) (g). Mobilization of the cyst into the lateral ventricle (h). Bimanual dissection (i).
Fig. 10.8 En-bloc removal of the cyst with grasping forceps (a). A 45° diagnostic scope is used to inspect the roof of the third ventricle, confirming integrity of the internal cerebral veins (V) and completeness of cyst removal (b). Final inspection of the foramen of Monro (c).

Fig. 10.9 The MR images of the same patient, taken at 2-year follow-up, confirm that there are no signs of cyst remnant or recurrence. The patient is doing well and free of symptoms.

11 Pineal Cysts

Although pineal cysts are mostly incidental findings on magnetic resonance imaging, large cysts may cause aqueductal compression and subsequent obstructive hydrocephalus. Occasionally, pineal cysts become symptomatic without apparent ventricular dilation. Most probably, these cysts act like a ball-valve resulting in intermittent obstruction of CSF flow within the aqueduct and increase in intraventricular pressure. In symptomatic pineal cysts with small ventricles, we prefer a microsurgical cyst extirpation via a supracerebellar-infratentorial approach. However, provided the ventricles are dilated, endoscopic cyst fenestration is an alternative treatment option.25 The best entry point for accessing a pineal cyst is a paramedian burr hole, placed far anteriorly (6–7 cm in front of the coronal suture) (Fig. 11.1). The cyst is incised and the yellowish protein-rich content rinsed out. Subsequently, a large cyst fenestration with partial resection of the wall is performed.

Fig. 11.1 Endoscope trajectory for a pineal cyst.
Case Presentation

21 – Pineal Cyst Fenestration with the Little LOTTA® Ventriculoscope – Click here or see page 5.

Fig. 11.2 The 38-year-old male presented with progressive headache and dizziness. MR imaging showed a large pineal cyst causing obstruction of aqueductal CSF flow and subsequent hydrocephalus (a–c). Narrow foramen of Monro (d). Massa intermedia in front of the pineal cyst (e). After dorsal retraction of the massa intermedia with the sheath, the pineal cyst can be approached (f). Coagulation of vessels (g). Incision of the cyst with scissors (h). Resection of the cyst wall with grasping forceps (i–j). Coagulation of fenestration margins (k). Wide fenestration of the cyst wall (l). Free entry of the aqueduct (➞) above the posterior commissure (m). Internal inspection of the cyst (n). A 45° diagnostic scope is used to visualize the choroid plexus and left internal cerebral vein at the roof of the third ventricle (o).

A final examination of the foramen of Monro confirms that integrity of veins and fornix has been preserved (p).

Key to Acronyms

icV | internal cerebral vein
M  | massa intermedia
P  | choroid plexus
pC | posterior commissure
Fig. 11.3 MR imaging obtained 3 years after surgery, showed a wide cyst fenestration and confirmed restoration of aqueductal CSF flow. There is a noticeable decrease in the size of the cyst and ventricular size. The patient's symptoms improved markedly.

12 Arachnoid Cysts

Arachnoid cysts are ideal indications for an endoscopic approach because of the wide cavity filled with cristal clear CSF which provides ample room for endoscopic manipulations. Arachnoid cysts may expand and compress the neighbouring brain structures or cause occlusive hydrocephalus. The goal of surgery is simply to create a communication between the cyst and the ventricles or cisterns.19,28 The cyst fenestration should be large to prevent reclosure of the opening by scarring. All symptomatic arachnoid cysts are an indication for surgery, given the absence of contraindications. The surgical indication for asymptomatic arachnoid cysts remains controversial. In my opinion, surgery for asymptomatic arachnoid cysts in adults is not justified. However, in children, who have large asymptomatic cysts with a significant mass effect that may impair the normal brain development, endoscopic treatment should be offered to the parents.

12.1 Suprasellar Arachnoid Cysts

Suprasellar arachnoid cysts usually cause occlusive hydrocephalus as a result of foraminal and/or aqueductal obstruction. In general, the approach is established without the use of neuronavigation. The burr hole is placed at an approx. 2.5 cm paramedian and 1 cm precoronal site. The endoscope is inserted into the lateral ventricle (Fig. 12.1). In most cases, the foramen of Monro is wide. A large fenestration of approx. 1 by 1 cm is made in the cyst wall with the aid of scissors. The bimanual technique can be used to prevent collapse of the cyst. The margins of fenestration are coagulated with a bipolar diathermy probe. Once a wide ventriculocystostomy has been created, the cyst lumen is entered. Usually, there is a good view of neurovascular structures in the prepontine area. In all cases of suprasellar cysts treated at our institution, we saw a valve mechanism around the basilar artery which is probably the major pathogenic factor for cyst formation.24 If possible, a second fenestration of the lower cyst wall should be made between the cyst and the basal cisterns to create a ventriculocystocisternostomy.

Fig. 12.1 Endoscope trajectory for suprasellar arachnoid cysts (with permission of Springer-Verlag Wien: M. Sindou. Practical Handbook of Neurosurgery: From Leading Neurosurgeons, Volumes 1–3, © 2009 Springer; Wien, New York.)
Case Presentation

22 – Ventriculocystocisternostomy of Suprasellar Arachnoid Cyst with the LOTTA® Ventriculoscope – Click here or see page 5.

The 9-year-old girl presented with a history of progressive headache which had started 1 year ago. MR imaging showed a large suprasellar arachnoid cyst with asymmetrical dilation of both lateral ventricles. Because of a wider left ventricle, the cyst is approached from the left side (a–d). Wide left foramen of Monro occluded by a cyst (e). Circular coagulation of the cyst wall (f). Incision of the cyst using a bimanual technique (g). The flap is removed once it has been circumferentially dissected with a Guillotine knife (h). Wide fenestration (i). Intraluminal inspection of the cyst shows the basilar a., posterior cerebral a., superior cerebellar a. and right oculomotor n. (j). A 30° diagnostic scope is used to visualize the basilar a., right posterior cerebral a., and right superior cerebellar a. (k). Looking posteriorly, the 45°-diagnostic scope confirms an unobstructed entry of the aqueduct (➞) above the posterior commissure (l). Anteriorly, the pituitary stalk and gland are revealed (m). Looking with the same scope to the right, the carotid a., ophthalmic a., and posterior communicating a., and anterior choroidal a. as well as the superior hypophyseal artery complex (➞) are visualized (n). Looking to the left, the small left posterior communicating artery with perforators is demonstrated (o). Slit-valve mechanism (➞) in the arachnoid surrounding the basilar artery (p).

Key to Acronyms

AC anterior choroidal artery
B basilar artery
Car carotid artery
oA ophthalmic artery
OC right oculomotor nerve
pC posterior commissure
PC posterior communicating artery
Pca posterior cerebral artery
Pg pituitary gland
Ps pituitary stalk
Sca superior cerebellar artery
Fig. 12.3 Using scissors, the arachnoid is incised around the basilar artery (a). The incision is enlarged with a Decq forceps (b). The perforation is enlarged with a balloon (c). Cystocisternostomy (d). View of the cistern demonstrating the left abducens nerve (e), the basilar and anterior inferior cerebellar artery, and the right abducens nerve (f). Foramen of Monro upon completion of ventriculocystocisternostomy (g). MR imaging obtained 3 months after surgery shows a wide fenestration (➞), a strong flow-void sign (➞), and a significant decrease in the size of the cyst and of the ventricles. The patient’s headache resolved completely (h–k).

**Key to Acronyms**

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<td>anterior inferior cerebellar artery</td>
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12.2 Sylvian Arachnoid Cysts

Sylvian arachnoid cysts may become symptomatic with headache, seizures, or hemi-syndromes. When headache is the only symptom, it is difficult to make sure that the cyst is in fact the underlying cause.

The patient is positioned supine with the head turned to the contralateral side. Depending on cyst size, the skin incision is placed more or less above the level of the zygomatic arch anterior to the ear. Neuronavigation is helpful to determine the ideal burr hole location and the best trajectory to the basal cisterns (Fig. 12.4).

Once an opening has been created in the dura, the arachnoid cyst wall is exposed. Vessels encountered in the arachnoid membrane are coagulated to prevent later hemorrhage, which may result from movements of the endoscope. Immediately after incision of the arachnoid, the sheath of the neuroendoscope should be inserted into the cyst to prevent excessive loss of CSF. Cottonoids are placed around the sheath in order to prevent blood from entering the cyst, leading to a blurred view of the operative site. The cyst is inspected and anatomical landmarks, such as the carotid and middle cerebral artery, optic and oculomotor nerves, are identified. Usually, the space best suited for fenestration is located between carotid artery and oculomotor nerve (Fig. 12.5). If this space is found to be too narrow, the fenestration may be placed laterally to the oculomotor nerve. Occasionally, the arachnoid membrane is incised medially to the carotid, too. Because of the tough arachnoid (for the most part in adults), the membrane has to be cut with scissors. Parts of the cyst wall can be removed with grasping forceps to create a wide opening. Once the opening in the cyst wall has been made, Liliequist’s membrane comes into view. This membrane has to be fenestrated as well to establish a communication to the prepontine cistern. The basilar artery should be identified to confirm that the prepontine cistern has been entered.

Fig. 12.4 Endoscope trajectory for Sylvian arachnoid cysts (with permission of Springer Verlag Wien: M. Sindou. Practical Handbook of Neurosurgery: From Leading Neurosurgeons, Volumes 1–3, © 2009 Springer; Wien, New York).

Fig. 12.5 Schematic drawing of a Sylvian arachnoid cyst. The condition is treated by fenestrating the cyst wall between carotid artery and oculomotor nerve, thus creating a communication to the prepontine cistern (with permission of Springer-Verlag Wien: M. Sindou. Practical Handbook of Neurosurgery: From Leading Neurosurgeons, Volumes 1–3, © 2009 Springer; Wien, New York).

Key to Acronyms (Fig. 12.4)

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<td>On</td>
<td>optic nerves</td>
</tr>
<tr>
<td>PC</td>
<td>posterior communicating artery</td>
</tr>
</tbody>
</table>

Key to Acronyms (Fig. 12.7)

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>anterior cerebral artery complex</td>
</tr>
<tr>
<td>AC</td>
<td>anterior choroidal artery</td>
</tr>
<tr>
<td>Car</td>
<td>carotid artery</td>
</tr>
<tr>
<td>M1/2</td>
<td>middle cerebral a. bifurcation</td>
</tr>
<tr>
<td>Mca</td>
<td>middle cerebral arteries</td>
</tr>
<tr>
<td>OC</td>
<td>oculomotor nerve</td>
</tr>
<tr>
<td>On</td>
<td>optic nerve</td>
</tr>
<tr>
<td>PC</td>
<td>posterior communicating artery</td>
</tr>
<tr>
<td>Pca</td>
<td>posterior cerebral artery</td>
</tr>
<tr>
<td>Ps</td>
<td>pituitary stalk</td>
</tr>
<tr>
<td>Sca</td>
<td>superior cerebellar artery</td>
</tr>
<tr>
<td>TB</td>
<td>temporal branch of middle cerebral artery</td>
</tr>
</tbody>
</table>
Case Presentation

23 – Cystocisternostomy of Sylvian Arachnoid Cyst with the LOTTA® Ventriculoscope – Click here or see page 5.

Fig. 12.6 The 8-year-old boy presented with persisting headache (a). MR imaging (a–c) showed a large Sylvian arachnoid cyst with midline shift and ventricular compression. Navigational planning of the approach (d).

Fig. 12.7 The 0° diagnostic scope shows the middle cerebral artery bifurcation, the temporal branch of the middle cerebral artery, the carotid a., and posterior communicating a., as well as the optic n. and oculomotor n. (a). More anteriorly, the optic nerves, carotid a., anterior and middle cerebral arteries are visualized (b). A posterior close-up view shows the optic n., oculomotor n., carotid a., posterior communicating a., and anterior choroidal artery (c). The thin membrane of the cyst and Liliequist's membrane are incised with scissors (d). The fenestration is enlarged with a Decq forceps (e). The arachnoid membrane is resected with biopsy forceps (f). Upon inspection of the interpeduncular cistern with a 30° diagnostic scope (diam. 2 mm), the pituitary stalk is shown (g). The same scope is used for scrutiny of the preopticine cistern, demonstrating the contralateral oculomotor nerve, posterior cerebral a., and superior cerebellar artery (h). Final aspect upon completion of the cystocisternostomy (i).

Key to Acronyms (see page 58).

Fig. 12.8 The MR imaging obtained 2 years after surgery confirmed a decrease in cyst size and showed a strong flow-void signal through the cystocisternostomy (➞). The patient's headache had resolved almost completely.
12.3 Arachnoid Cysts of the Posterior Cranial Fossa

In small arachnoid cysts covered by the cerebellum, the author prefers the use of an endoscope-assisted microsurgical technique in order to preserve integrity of the overlying brain tissue. Conversely, in larger cysts, displacing the cerebellum from the entry point, an endoscopic approach is recommended. Patients with cysts of the cerebellopontine angle are positioned supine with the head turned to the contralateral side. The burr hole is placed just over the cyst. A wide cystocisternostomy is performed between the cranial nerves. Patients with midline cysts are placed prone with the head anteflexed (Concorde position).

Case Presentation

24 – Cystocisternostomy of Cerebellopontine Angle Arachnoid Cyst with the LOTTA® Ventriculoscope – Click here or see page 5.

Fig. 12.9 The 32-year-old female presented with headache, dizziness, and balance problems. MR imaging showed a large arachnoid cyst in the cerebellopontine angle with significant cerebellar and brain stem compression. The cranial nerves were stretched around the cyst.

Fig. 12.10 The facial n., vestibulocochlear n., glossopharyngeal n., and vagal n. are visualized (a). The cyst membrane is incised in between nerves VII/VIII and IX with scissors (b). The fenestration is enlarged with a Decq forceps (c). Using a Guillotine knife, the arachnoid membrane is incised (d). The cistern is inspected with a 30° diagnostic scope demonstrating abducens nerve, anterior inferior cerebellar a., basilar a. and vertebral a., which are seen to converge at the vertebrobasilar (➞) junction (e). Entry of abducens nerve into Dorello’s canal (➞) and anterior inferior cerebellar artery (f). Final aspect upon completion of cystocisternostomy (g).

Key to Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AI</td>
<td>anterior inferior cerebellar artery</td>
</tr>
<tr>
<td>AN</td>
<td>abducens nerve</td>
</tr>
<tr>
<td>B</td>
<td>basilar artery</td>
</tr>
<tr>
<td>Fn</td>
<td>facial nerve</td>
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<tr>
<td>G</td>
<td>glossopharyngeal nerve</td>
</tr>
<tr>
<td>V</td>
<td>vertebral artery</td>
</tr>
<tr>
<td>VC</td>
<td>vestibulocochlear nerve</td>
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<tr>
<td>Vn</td>
<td>vagal nerve</td>
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</table>
Fig. 12.11 MR imaging obtained 3 months after surgery showed a wide fenestration (➞) (b), decrease in cyst size, and a strong flow-void signal through the cystocisternostomy (➞) (c). The patient’s headache resolved, but dizziness persisted.

Case Presentation

25 – Cystoventriculostomy of Posterior Fossa Arachnoid Cyst with the LOTTA® Ventriculoscope — Click here or see page 5.

Fig. 12.12 The 60-year-old female presented with recurrent headaches, balance problems, and ataxia. MR imaging revealed a huge posterior fossa arachnoid cyst and chronic hydrocephalus.

Fig. 12.13 Endoscopic inspection of the cyst reveals a very thick arachnoid membrane (a). The most suitable site for cyst fenestration is determined (b). The cyst is fenestrated with the bimanual technique (c). A large opening is created with scissors (d). The fourth ventricle is entered through the fenestration revealing the floor of the rhomboid fossa and the aqueduct (➞) (e). Choroid plexus running to the contralateral foramen of Luschka (f). Choroid plexus, vertebral artery and PICA lateral to the medulla oblongata (g). Viewing downward into the spinal canal with the 45°-endoscope reveals the junction of medulla and spinal cord (h).

Key to Acronyms

- M medulla oblongata
- P choroid plexus
- PI posterior inferior cerebellar artery (PICA)
- R rhomboid fossa
- V vertebral artery
12.4 Intraventricular Arachnoid Cysts

Intraventricular arachnoid cysts usually present with occlusive hydrocephalus. The approach is subject to location and size of the cyst. Small cysts are resected. Larger cysts are fenestrated toward the ventricles.

Case Presentation

Fig. 12.14 MR imaging obtained 2 years after surgery showing the wide fenestration (arrows), but only a minimal decrease in cyst size. However, the symptoms improved amazingly with only rarely occurring headaches and normal balance.

Fig. 12.15 The 32-year-old female presented with headache. MR imaging showed a multicystic lesion (➞), blocking the left foramen of Monro and causing unilateral hydrocephalus.

Fig. 12.16 Subependymal cysts obstructing the left foramen of Monro (a). Coagulation of vessels on the cyst wall (b). Incision of the cyst wall with scissors (c). Under the ependyma, an arachnoid membrane is clearly visualized (d). The cyst wall is grasped with flexible forceps (e). Bimanual resection of the cyst (f).
Intraparenchymal Cysts

Intraparenchymal cysts are CSF-filled space-occupying lesions lined with ependymal or gliotic tissue. Depending on their location, they may cause hemisyndromes, ataxia, visual problems, hemianopsia etc. All symptomatic intraparenchymal cysts are an indication for surgery. The aim of surgery is to establish a sufficient communication to the normal CSF pathways, usually the ventricles. The opening should be large to prevent reclosure by scarring. Navigation is mandatory to determine the optimal trajectory and to identify the best suited fenestration site, taking into account that, in most cases, there are virtually no anatomical landmarks within the cyst cavity. A very useful technique to identify the thinnest part of the cyst wall is the jet irrigation technique. With short repeated episodes of forced irrigation, the thinnest part of the wall, that moves the most, is easily found.6

Case Presentation

27 – Cystoventriculostomy of Intraparenchymal Cyst with the LOTTA® Ventriculoscope – Click here or see page 5.
Fig. 13.2 Inspection of the cyst wall (a). Employing intermittent jet irrigation, the thinnest portion of the cyst wall, located adjacent to the lateral ventricle, is identified (b). Coagulation and perforation of the cyst wall using a bipolar electrode (c). Appearance of the cyst wall after perforation (d). Cutting of the remaining tissue bridges after coagulation with scissors (e). The cyst wall is resected with biopsy forceps (f). View through the fenestration into the lateral ventricle with the 0° diagnostic scope, showing the thin septum pellucidum (g). A 30° diagnostic scope is used to show the choroid plexus of the lateral ventricle and the thalamostriate vein (h). Final aspect upon completion of the cystoventriculostomy (i).

Key to Acronyms

| P  | choroid plexus |
| T  | thalamostriate vein |

Fig. 13.3 MR imaging obtained 1 year after surgery confirmed a decrease in cyst size and demonstrated a wide opening in the cyst wall (➞). The neurological deficits resolved completely.

Case Presentation

28 – Ventriculocystostomy of Intraparenchymal Cyst with the LOTTA® Ventriculoscope – Click here or see page 5.

Fig. 13.4 The 42-year-old female presented with diplopia and dizziness. MR imaging showed a large midbrain cyst with brain stem compression (a–c). Navigational planning of the approach (d).
Fig. 13.5 Small foramen of Monro (a). Visualization of the cyst after passing the foramen of Monro (b). The cyst wall is coagulated with a bipolar electrode (c). Appearance of the cyst wall after perforation (d). Tissue bridges between the coagulation sites are cut with scissors (e). The wall is resected with a biopsy forceps (f). Viewing through the fenestration up to the roof of the third ventricle, the 45° diagnostic scope reveals the internal cerebral veins, habenular commissure and choroid plexus (g). The distal cyst wall is punctured with a balloon catheter to create an opening to the aqueduct (h). The balloon of the catheter is inflated (i). Through the distal fenestration, the choroid plexus of the fourth ventricle is demonstrated (j). Upon final inspection, the two cyst fenestrations are visualized (k). Foramen of Monro after ventriculocystostomy (l).

**Key to Acronyms**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>IC</td>
<td>internal cerebral veins</td>
</tr>
<tr>
<td>HC</td>
<td>habenular commissure</td>
</tr>
<tr>
<td>P</td>
<td>choroid plexus</td>
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</table>

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Fig. 13.6 MR imaging obtained 3 years after surgery confirmed a decrease in cyst size and demonstrated a wide opening in the cyst wall. The patient's neurological deficits resolved completely. To date, 6 years after surgery, the patient is doing fine without recurrence of the cyst.
Endoscopic lavage in ventriculitis and intraventricular hemorrhage is an evolving technique that facilitates a more rapid clearance of CSF from infectious material as well as from blood clots and debris. This aids in reducing the time that needs to elapse before a shunt is implanted. Recent data suggest that in some cases of intraventricular hemorrhage, endoscopic lavage completely obviates the need for shunt placement. The author prefers the use of the LOTTA® ventriculoscope because of its large working channel which allows irrigation to be performed more effectively. Furthermore, large suction tubes and grasping forceps can be used to remove contents of more solid consistency from the ventricle. In premature newborns or newborns, usually the Little LOTTA® ventriculoscope is used. In clinical practice, however, both the LOTTA® and the Little LOTTA® are frequently used in one procedure. While on the one hand the standard LOTTA® ventriculoscope is applied in the lateral ventricles, the little LOTTA® is required in the third ventricle because the foramina of Monro are usually too narrow for the standard LOTTA® ventriculoscope to be inserted.

The patient is positioned supine with the head slightly flexed. The entry point is usually the same as for third ventriculostomy (Fig. 14.1a), but occasionally a more lateral site is chosen depending on the ventricles to be approached (Fig. 14.1b). Most commonly, a septostomy is performed to clean the contralateral ventricle as well. The third ventricle is approached via the foramen of Monro. After completion of the procedure, a Rickham reservoir can be implanted.

### Case Presentation

**29 – Lavage in the Treatment of Ventriculitis with the Standard LOTTA® and the Little LOTTA® Ventriculoscope**

The 1-month-old female presented with perinatal streptococcus B ventriculitis. MR imaging showed a tetraventricular hydrocephalus with contrast-enhancing ventricular walls (a–c). Even though immediate antibiotic treatment was administered, MR imaging revealed progressive hydrocephalus and intraventricular ventriculitis-related content accumulation (d).
Ventriculitis and Intraventricular Hemorrhage

Conclusions

The LOTTA® ventriculoscopic system has been used since 2008 at the author's institution. To date (2017), approximately 300 endoscopic intracranial procedures have been performed. The system has been shown to be very reliable and sturdy. None of the procedures performed so far with the LOTTA® system had to be discontinued on account of problems related to technical issues. On a regular basis, the system is subjected to cleaning, disinfection, and sterilization in the central medical device reprocessing unit. While adhering strictly to standardized reprocessing protocols, not a single case of damage to the LOTTA® system has occurred. The LOTTA® system provides the neurosurgeon with a versatile tool that is suited to perform any kind of intracranial endoscopic procedures.
References


Recommended Sets for Neuro-Endoscopy – Intracranial Surgery

The Standard and Little LOTTA® Ventriculoscopes
Telescopes, Sheaths, Instruments and Powered Instrumentation
POINT SETTER® Pneumatic Holding System
Videoendoscopic Equipment – IMAGE1 S™ FULL HD Camera System
Neuro-Endoscopy – Intracranial Surgery
LOTTA® Basic Set
Neuro-Endoscopy – Intracranial Surgery

LOTTA® Basic Set

SCHROEDER LOTTA® Recommended Set for Neuro-Endoscopy – Intracranial Surgery

Telescopes and Sheaths

1. 28164 LA  LOTTA® Ventriculoscope with HOPKINS® Wide Angle Straight Forward Telescope 6°, 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: green

2. 28164 LS  Operating Sheath, graduated, rotating, outer diameter 6.8 mm, working length 13 cm

3. 28164 LO  Obturator, for use with Operating Sheath 28164 LS and 28164 LSB

4. 533 TVA  Adaptor, autoclavable, permits telescope changing under sterile conditions

Instruments

1. 28164 LB  CLICKLINE Scissors, pointed, single action jaws, diameter 2 mm, working length 30 cm

2. 28164 LC  CLICKLINE Biopsy Forceps, double action jaws, diameter 2 mm, working length 30 cm

3. 28164 LD  CLICKLINE Forceps, for ventriculostomy, diameter 2 mm, working length 30 cm

4. 28164 LE  CLICKLINE Grasping Forceps, double action jaws, diameter 2 mm, working length 30 cm

5. 28164 LF  CLICKLINE Biopsy Forceps, single action jaws, diameter 2.7 mm, working length 30 cm

6. 28762 KB  Bipolar Coagulation Electrode, diameter 1.7 mm, working length 30 cm

7. 28160 ZJ  Biopsy Forceps, flexible, double action jaws, diameter 1 mm, working length 30 cm

8. 28160 TV  Forceps, for ventriculostomy, flexible, diameter 1 mm, working length 30 cm

9. 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

Holding System

10. 28272 RKA  Holding System, autoclavable
   including:
   - Socket, to clamp to the OR table
   - Articulated Stand, straight
   - Clamping Jaw, metal, with axial intake

Optional

11. 28164 LP  Optical Obturator, for positioning Operating Sheath 28164 LS and 28164 LSB under visual control, for use with HOPKINS® Telescope 28008 AA

12. 28008 AA  HOPKINS® Straight Forward Telescope 0°, enlarged view, diameter 2 mm, length 26 cm, autoclavable, fiber optic light transmission incorporated, color code: green

13. 28162 EM  Scissors, pointed, slightly curved, double action jaws, diameter 1.7 mm, working length 30 cm

14. 28162 FP  Scissors, pointed, single action jaws, diameter 1.3 mm, working length 30 cm

For diagnosis

15. 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

16. 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

17. 28007 FA  HOPKINS® Telescope 45°, enlarged view, diameter 3.3 mm, length 25 cm, autoclavable, fiber optic light transmission incorporated, color code: black

Recommended containers for sterilization:

Angled eyepiece: 39314G
Instruments: 27717 D

It is recommended to check the suitability of the product for the intended procedure prior to use.
Neuro-Endoscopy – Intracranial Surgery
Little LOTTA® Recommended Set
Neuro-Endoscopy – Intracranial Surgery
Little LOTTA® Recommended Set

SCHROEDER Little LOTTA® Recommended Set for Neuro-Endoscopy – Intracranial Surgery

Telescope and Sheath:

1. 28164 LLA Little LOTTA® Venticuloscope with HOPKINS® Wide Angle Straight Forward Telescope 6°,
small, angled eyepiece, outer diameter 3.6 mm, length 18 cm, with working channel diameter 1.6 mm,
autoclavable, with cleaning adaptor,
fiber optic light transmission incorporated, color code: green, for use with small Operating Sheath 28164 LLS

2. 28164 LLS Operating Sheath, small, outer diameter 4.5 mm, working length 13.3 cm,
for use with Little LOTTA® Venticuloscope 28164 LLA

3. 28164 LLO Obturator, for use with Operating Sheath 28164 LLS

4. 28164 LLP Optical Obturator, for use with Operating Sheath 28164 LLS and HOPKINS® Telescope 28008 AA

5. 533 TVA Adaptor, autoclavable, permits telescope changing under sterile conditions

6. 28008 AA HOPKINS® Straight Forward Telescope 0°, enlarged view, diameter 2 mm, length 26 cm, autoclavable,
fiber optic light transmission incorporated, color code: green

Instruments:

7. 28161 SC Scissors, single action jaws, diameter 1.3 mm, working length 30 cm

8. 28161 SB Biopsy Forceps, double action jaws, diameter 1.3 mm, working length 30 cm

9. 28161 SG Grasping Forceps, double action jaws, diameter 1.3 mm, working length 30 cm

10. 28161 SF Bipolar Coagulation Electrode, diameter 1.3 mm, working length 30 cm

11. 28161 SE Coagulation Electrode, unipolar, diameter 1.3 mm, working length 30 cm

12. 28160 TV Forceps, for ventriculostomy, flexible, double action jaws, diameter 1 mm, working length 30 cm

Holding System:

13. 28272 RKA Holding System, autoclavable, with quick release coupling KSLOCK,
including:
    Rotation Socket, to clamp to the OR table, for European and US standard rails,
    with lateral clamp for height and angle adjustment of the articulated stand
    Articulated Stand, reinforced version, straight, with one mechanical central clamp for all five joint
functions, height 30 cm, swivel range 37 cm, with quick release coupling KSLOCK (female)
    Clamping Jaw, metal, clamping range 4.8 up to 12.5 mm, with quick release coupling KSLOCK (male)

For Diagnosis:

14. 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

15. 28007 FA HOPKINS® Telescope 45°, enlarged view, diameter 3.3 mm, length 25 cm, autoclavable,
fiber optic light transmission incorporated, color code: black
LOTTA® Ventriculoscope 6°
Operating Sheath, outer diameter 6.8 mm

SCHROEDER Recommended Set

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

LOTTA® Ventriculoscope with HOPKINS®
Wide Angle Straight Forward Telescope 6°,
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: green

28164 LA
28164 LS
28164 LO
28164 LP

28008 AA

HOPKINS® Straight Forward Telescope 0°,
enlarged view, diameter 2 mm, length 26 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: green
**LOTTA® Ventriculoscope 30°**
Operating Sheath, outer diameter 6.8 mm

28164 LAB/28164 LSB

28164 LO

28164 LP

28008 AA

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

28164 LSB

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 HOPKINS® Telescope 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
LOTTA® Ventriculoscope
Operating Instruments

SCHROEDER Recommended Set
Operating Instruments for use with LOTTA® Ventriculoscope 28164 LA / 28164 LAB
and Operating Sheath 28164 LS / 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 LF

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
**LOTTA® Ventriculoscope**

**Operating Instruments**

**SCHROEDER Recommended Set**

Operating Instruments for use with LOTTA® Ventriculoscope 28164 LA / 28164 LAB and Operating Sheath 28164 LS / 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
LOTTA® Ventriculoscope
Diagnostic HOPKINS® Telescopes

SCHROEDER Recommended Set
Diagnostic HOPKINS® Telescopes for use with Operating Sheath 28164 LS / 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
Little LOTTA® Ventriculoscope
Operating Sheath, outer diameter 4.5 mm

SCHROEDER Little LOTTA® Recommended Set

- Small outer diameter provides excellent image quality
- Slender sheath (diameter 4.5 mm) enables direct exploration of the prepontine cistern via ventriculostomy – particularly suitable, therefore, for patients with arachnoidal membranes in the interpeduncular and/or prepontine cisterns
- Suitable for all patients with narrow foramen of Monro – both adult and pediatric patients
- Suitable for performing ventriculostomies, septostomies, tumor biopsies and cyst fenestration
- Not suitable for the removal of colloidal cysts, tumor resections and stent implantations – the Standard LOTTA® is still recommended in these cases

28164 LLA

Little LOTTA® Ventriculoscope with HOPKINS®
Wide Angle Straight Forward Telescope 6°,
small, angled eyepiece, outer diameter 3.6 mm,
length 18 cm, with working channel diameter 1.6 mm,
irrigation/suction channel diameter 0.8 mm,
autoclavable, with cleaning adaptor,
fiber optic light transmission incorporated,
color code: green

28164 LLS

Operating Sheath, small, outer diameter 4.5 mm,
working length 13.3 cm,
for use with Little LOTTA® Ventriculoscope 28164 LLA

28164 LLO

Obturator, for use with Operating Sheath 28164 LLS

28164 LLP

Optical Obturator, for use with Operating Sheath 28164 LLS
and HOPKINS® Telescope 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
Little LOTTA® Ventriculoscope
Operating Instruments

SCHROEDER Recommended Set
Operating Instruments for use with Little LOTTA® Ventriculoscope 28164 LLA
and Operating Sheath 28164 LLS

28161 SC  Scissors, single action jaws, diameter 1.3 mm, working length 30 cm
28161 SB  Biopsy Forceps, double action jaws, diameter 1.3 mm, working length 30 cm
28161 SG  Grasping Forceps, double action jaws, diameter 1.3 mm, working length 30 cm
28161 SF  Bipolar Coagulation Electrode, diameter 1.3 mm, working length 30 cm
28160 TV  Forceps, for ventriculostomy, flexible, double action jaws, diameter 1 mm, working length 30 cm

Diagnostic HOPKINS® Telescopes
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
Holding System
POINT SETTER® Pneumatic Holding System

28172 WKS  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, elasticated, 42 x 164 cm, for single use, sterile, for use with KARL STORZ holding arms, package of 20
041150-80*  Same, package of 80
Application of the LOTTA® Ventriculoscopic System in Clinical Practice

UNIDRIVE® S III NEURO SCB
System Components

UNIT SIDE

PATIENT SIDE

Two-Pedal Footswitch

Single Use Tubing Set

20016630

031131-10

High-Speed Micro Motor

Perforator

20 712033

252640

High Performance EC Micro Motor II

INTRA Drill Handpiece, 80,000 rpm

252573 – 252575

20 711033

20 711173

252645

252640

252570 – 252572, 252590 – 252592

109 20 712033

20 712050

20 712055

High-Speed Handpieces, 100,000 rpm

Dermatomes

High-Speed Handpieces, 60,000 rpm

Micro Saw

High-Speed Micro Motor

Craniotome

INTRA Drill Handpiece, 40,000 rpm

High-Speed Handpieces, 100,000 rpm

252690 – 252682

253300

252660 – 252663, 252690 – 252692, 252671 – 252672

254000

INTRA Drill Handpiece, 40,000 rpm

252690

252671

252700

40,000 rpm

80,000 rpm

Not for Sale in the US for Spine or Neuro Indications
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

Specifications:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
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</thead>
<tbody>
<tr>
<td>Touch Screen</td>
<td>6.4”/300 cd/m²</td>
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<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>
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<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>
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</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

Perforator Handpiece, 1200 rpm

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

Perforator Handpiece, max. speed 1200 rpm, without perforator blade, Hudson connector, for use with High-Speed Micro-Motor 20712033

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
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

UNIDRIVE® S III NEURO SCB
For use with High-Speed Micro-Motor 20 7120 33

Perforator Handpiece: 252640

- Instruments with Hudson connectors

- **Single-Use Cranial Perforators**
  - 252641 14/11 mm
  - 252642 11/7 mm

Craniotome Handpiece: 252645

- Use with 3.17 mm craniotome burrs

- **Dura Protector**
  - pediatric: 252646
  - medium: 252647
  - long: 252648

- Craniotome Burrs
  - 360000 S
  - 360000 M
  - 360000 L

Not for Sale in the US for Spine or Neuro Indications
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 for Sale in the US for Spine or Neuro Indications
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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<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 Diamond Burrs, 100,000 rpm, for single use, sterile, package of 5

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>short</th>
<th>medium</th>
<th>long</th>
</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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<td>5</td>
<td>350250 S</td>
<td>350250 M</td>
<td>350250 L</td>
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<tr>
<td>6</td>
<td>350260 S</td>
<td>350260 M</td>
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<tr>
<td>7</td>
<td>350270 S</td>
<td>350270 M</td>
<td>350270 L</td>
</tr>
</tbody>
</table>

Not for Sale in the US for Spine or Neuro Indications
### 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></th>
<th>High-Speed Coarse Diamond Burrs, 100,000 rpm, for single use, sterile, package of 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter in mm</td>
<td>short</td>
</tr>
<tr>
<td>3</td>
<td>350330 S</td>
</tr>
<tr>
<td>4</td>
<td>350340 S</td>
</tr>
<tr>
<td>5</td>
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<tr>
<td>6</td>
<td>350360 S</td>
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<tr>
<td>7</td>
<td>350370 S</td>
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<table>
<thead>
<tr>
<th></th>
<th>High-Speed Acorns, 100,000 rpm, for single use, sterile, package of 5</th>
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<tbody>
<tr>
<td>Diameter in mm</td>
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<tr>
<td>7.5</td>
<td>350675 S</td>
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<tr>
<td>9</td>
<td>350690 S</td>
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<table>
<thead>
<tr>
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<th>High-Speed Barrel Burrs, 100,000 rpm, for single use, sterile, package of 5</th>
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<tbody>
<tr>
<td>Diameter in mm</td>
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<tr>
<td>6</td>
<td>350960 S</td>
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<tr>
<td>9.1</td>
<td>350991 S</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>High-Speed Neuro Fluted Burrs, 100,000 rpm, for single use, sterile, package of 5</th>
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</thead>
<tbody>
<tr>
<td>Diameter in mm</td>
<td>short</td>
</tr>
<tr>
<td>1.8</td>
<td>350718 S</td>
</tr>
<tr>
<td>3</td>
<td>350730 S</td>
</tr>
</tbody>
</table>

Not for Sale in the US for Spine or Neuro Indications

![Image of UNIDRIVE® S III NEURO SCB burrs](image-url)
IMAGE1 S™ – A System for all Requirements

- 10 mm 3D video endoscope
- 4 mm 3D video endoscope
- Flexible video endoscopes
- 1-chip camera heads
- PDD in FULL HD
- Microscopy camera head
- Near-Infrared (NIR/ICG) 3-chip camera head FI
- 3-chip camera heads
- Open for future technologies

Connects all technologies
IMAGE1 S CONNECT®

- VITOM® 3D
- 4K camera head
- 3D endoscopy IMAGE1 S D3-LINK™
- 4K endoscopy IMAGE1 S 4U-LINK
- 2D rigid / flexible endoscopy IMAGE1 S X-LINK
- 2D endoscopy IMAGE1 S H3-LINK

Application of the LOTTA® Ventriculoscopic System in Clinical Practice
IMAGE1 S™
As individual as your requirements

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, the camera platform offers expanded compatibility and connectivity for NIR/ICG fluorescence imaging, integration of operating microscopes and the use of VITOM® 3D exoscopes.

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

| Standard Image | CLARA |

CLARA + CHROMA: Homogeneous illumination and contrast enhancement

| Standard Image | CLARA + CHROMA |

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

| Standard Image | *SPECTRA A |

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

| Standard Image | *SPECTRA B |

*SPECTRA A / SPECTRA B: Not available for sale in the U.S.A.
Application of the LOTTA® Ventriculoscopic System in Clinical Practice

**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

**Side-by-side View:**
Parallel display of standard image and “SPECTRA B”

**Dashboard**
Status indication icons

**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

*S SPECTRA 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 A / SPECTRA B: Not for sale in the U.S.A.
TC 201EN* IMAGE1 S CONNECT® II, connect module, for use with up to 3 link modules, resolution 3840x2160 and 1920x1080 pixels, with integrated KARL STORZ-SCB and digital Image Processing Module, power supply 100 - 240 VAC, 50 / 60 Hz including:
- Mains Cord, length 300 cm
- DVI-D Connecting Cable, length 300 cm
- Display Port Cable, 300 cm
- SDI Cable, 300 cm
- SCB Connecting Cable, length 100 cm

*Available in the following languages: DE, ES, FR, IT, PT, RU
Please indicate the required language code when placing your order

For use with IMAGE1 S CONNECT® II Module TC 201EN

TC 304 IMAGE1 S 4U-LINK, link module, for use with IMAGE1 S 4U camera heads, power supply 100 – 120 VAC / 200 – 240 VAC, 50 / 60 Hz including:
- Mains Cord, length 300 cm
- Link Cable, length 20 cm, for use with IMAGE1 S CONNECT® II TC 201EN

TC 300 IMAGE1 S H3-LINK®, link module, for use with IMAGE1 S™ FULL HD three-chip camera heads, power supply 100 – 120 VAC / 200 – 240 VAC, 50 / 60 Hz including:
- Mains Cord, length 300 cm
- Link Cable, length 20 cm, for use with IMAGE1 S CONNECT® II TC 201EN
Application of the LOTTA® Ventriculoscopic System in Clinical Practice

**IMAGE1 S™**

One-Chip 4K UHD Camera Head and Three-Chip FULL HD Camera Heads

**IMAGE1 S 4U, One-Chip 4K UHD Camera Head, for use with TC 304, IMAGE1 S 4U-LINK, module for 4K endoscopy**

**Specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame rate</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Image sensor</td>
<td>one-chip</td>
</tr>
<tr>
<td>Resolution</td>
<td>3840 x 2160 pixels</td>
</tr>
<tr>
<td>Scanning method</td>
<td>progressive scan</td>
</tr>
<tr>
<td>Lens</td>
<td>fixed focus</td>
</tr>
<tr>
<td>Focal length</td>
<td>f = 18 mm</td>
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<tr>
<td>Dimensions (w x h x d)</td>
<td>46 x 37 x 133 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>210 g</td>
</tr>
</tbody>
</table>

S-technologies available, progressive scan, soakable, gas- and plasma-sterilizable, focal length f = 18 mm, 2 freely programmable camera head buttons, for use with IMAGE1 S 4U-LINK

* SPECTRA A / SPECTRA B: Not for sale in the U.S.A.

**Three-Chip FULL HD Camera Heads**

**IMAGE1 S™ FULL HD three-chip camera heads for use with TC 300, IMAGE1 S H3-LINK, link module for rigid endoscopy**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Details</th>
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<tbody>
<tr>
<td>TH 100</td>
<td>IMAGE1 S H3-Z Three-Chip</td>
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<tr>
<td></td>
<td>FULL HD Camera Head</td>
<td></td>
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<tr>
<td>TH 103</td>
<td>IMAGE1 S H3-P Three-Chip Pendulum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Camera Head</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lens</td>
<td>fixed focus</td>
</tr>
<tr>
<td></td>
<td>Optical interface</td>
<td>Parfocal Zoom Lens</td>
</tr>
<tr>
<td></td>
<td>Dimensions (w x h x d)</td>
<td>35 x 47 x 88 mm</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>226 g</td>
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<tr>
<td></td>
<td>Cable length</td>
<td>300 cm</td>
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<tr>
<td></td>
<td>Camera head buttons</td>
<td>freely programmable</td>
</tr>
<tr>
<td></td>
<td>Cable routing</td>
<td>angled</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Details</th>
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<tbody>
<tr>
<td>TH 104</td>
<td>IMAGE1 S H3-ZA Three-Chip</td>
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<tr>
<td></td>
<td>FULL HD Camera Head</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lens</td>
<td>fixed focus</td>
</tr>
<tr>
<td></td>
<td>Optical interface</td>
<td>Parfocal Zoom Lens</td>
</tr>
<tr>
<td></td>
<td>Dimensions (w x h x d)</td>
<td>39 x 49 x 100 mm</td>
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<td>Camera head buttons</td>
<td>freely programmable</td>
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<tr>
<td></td>
<td>Cable routing</td>
<td>angled</td>
</tr>
</tbody>
</table>

S-technologies CLARA, CHROMA, SPECTRA*

Degree of protection

* SPECTRA A / SPECTRA B: Not for sale in the U.S.A.
Monitors

**TM 342**  31" 4K Monitor, screen resolution 3840 x 2180, image format 16:9, power supply 100 – 240 VAC, 50/60 Hz, with VESA 100 and VESA 200 adaption including:
- **External 48 VDC Power Supply**
- 1x Mains Cord
- 1x Cable Cover
- 2x Screws for cable cover
- 4x Mounting Screws M4
- 4x Mounting Screws M6
- 1x Instructions for use

**TM 220**  27" FULL HD Monitor, screen resolution 1920 x 1080, image format 16:9, power supply 100 – 240 VAC, 50/60 Hz, 5 VDC output (1 A), with VESA 100 adaption including:
- 1x **External 24 VDC Power Supply**
- 1x Mains Cord
- 1x Cable Cover
- 4x Mounting Screws M4
Cold Light Fountain Power LED 300

**TL 300**

*Cold Light Fountain Power LED 300*, with integrated KARL STORZ-SCB, high-performance LED module and one KARL STORZ light outlet, power supply 100 – 240 VAC, 50 / 60 Hz, including:

**Mains Cord**

Fiber Optic Light Cable

**495 NL**

*Fiber Optic Light Cable*, with straight connector, diameter 3.5 mm, length 180 cm

**495 NA**

*Same*, length 230 cm
Equipment Cart

Equipment Cart
wide, tall, rides on 4 antistatic dual wheels
equipped with locking brakes, 3 shelves,
mains switch on top cover, central beam package with
integrated electrical subdistributors with 12 sockets,
grounding plugs

Dimensions (w x h x d):
Equipment cart: 830 x 1474 x 730 mm,
Shelf: 630 x 25 x 510 mm,
Caster diameter: 150 mm

consisting of:
Base module, equipment cart, wide
Cover, equipment cart, wide
Beam package, equipment cart, tall
3 x Shelf, wide
Drawer unit with lock, wide
2 x Equipment rail, long
Camera holder
2 x Mains Cord, length 100 cm

Monitor Swivel Arm,
height- and side-adjustable,
mountable on the left or right,
swivel range 180°, overhang 780 mm,
overhang from centre 1170 mm,
load capacity max. 15 kg,
with monitor fixation VESA 5/100,
for use with equipment carts UG xxx
Recommended Accessories for Equipment Cart

**UG 310**
*Isolation Transformer*,
200 V–240 V; 2000 VA with 3 special mains sockets, automatic cut-out, 3 grounding plugs, dimensions: 330 x 90 x 495 mm (w x h x d), for use with Equipment Carts UG xxx

**UG 410**
*Earth Leakage Monitor*,
200 V–240 V, for mounting to equipment cart, control panel dimensions: 44 x 80 x 29 mm (w x h x d), for use with Isolation Transformer UG 310

**UG 510**
*Monitor Holding Arm*,
height- and side-adjustable, tilting, mountable to the left or right, swivel range up to 320°, overhang 530 mm, load capacity max. 15 kg, monitor mount VESA 75/100, for use with Equipment Carts UG xxx
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 300-XX*

**AIDA® Documentation System**, for recording of images and videos, dual channel, 4K, 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 350-XX*

**AIDA® Documentation System**, for recording of images and videos, dual channel, 4K, Full HD, 2D/3D, with SMARTSCREEN® (Touchscreen) 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 required language code (DE, EN, ES, FR, IT, PT, RU) when placing your order.
Notes:

Please note that the described products in this medium may not be available yet in all countries due to different regulatory requirements.
Notes: