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1.0 Introduction

1.1 Historical Review

The idea of endoscopic surgery derives from efforts to minimize surgical trauma while achieving optimum efficiency. Today this concept is more important than ever, as more and more patients with incidental findings are being referred to operative treatment. The concept of introducing an optical instrument into a body cavity has ancient roots. The Babylonians described the use of vaginal specula in approximately 500 A.D., with illumination provided by ambient light. By the early 20th century, the problem with all endoscopic techniques was poor illumination. Harold H. Hopkins was the first to use glass instead of air as a light conductor. This increased the refractive index of the system, resulting in improved light conduction. In 1963 Gerard Guiot described a scope designed for intracranial use. His scope had a powerful external light source whose illumination was carried via glass fibers to the distal tip of the scope.

Sir Walter Dandy was the first to perform an open ventriculostomy and published the first report on a new ventriculostomy technique in 1922. He used a simple endoscopic instrument, similar to a funnel, in which light was reflected from a head mirror and directed into the operative field for illumination. In 1923, W. J. Mixter performed the first successful endoscopic third ventriculostomy in a 9-month-old child with congenital hydrocephalus using a Nitze cystoscope. Despite technical advances, neuroendoscopy at that time had an unacceptably high mortality rate of approximately 30% stemming from complications such as intraventricular hemorrhage and infections. The shunt was introduced as a safer treatment option for hydrocephalus in 1952, and the early era of neuroendoscopy came to an end.

In 1966, H. H. Hopkins and Karl Storz developed a rigid scope that employed Selfoc lenses, known also as “rod lenses”. The refractive index of the Selfoc lens varies with the size of the lens, thus making it possible to enlarge the field of view. Another breakthrough was the use of fiberoptics. In 1963, Scarf first described an endoscopic third ventriculostomy using fiberoptics with an external light source.

The working instruments, e.g. grasping forceps, have also undergone continual advances. Today, endoscopic third ventriculostomy has become the technique of choice for the treatment of obstructive hydrocephalus.

1.2 Hydrocephalus and its Treatment Options

The most widely used treatment for both communicating and noncommunicating hydrocephalus is the implantation of a shunt system with an interposed valve. This is a bypass system which drains CSF from the ventricular system and directs it into an extracranial body compartment, where it is reabsorbed. Ventriculoperitoneal and ventriculoatrial shunts are most commonly used today. This type of treatment has become a simple and safe procedure due to constant advances in valve technology. On the other hand, shunt revisions are frequently necessary for a variety of reasons. One of the main causes of shunt-associated complications relates to the implantation of foreign material, which poses a risk of infection. According to Platt et al., new patients with hydrocephalus can expect to undergo between two and four operations for the revision of CSF shunts during the first 10 years after diagnosis. An alternative to shunt implantation for obstructive hydrocephalus is endoscopic ventriculostomy. At first this procedure was rejected due to its high initial morbidity and mortality.
Following the development of the HOPKINS® rod-lens telescope by H. H. Hopkins and Karl Storz, and the resultant significant improvement of intraoperative visualization, the endoscopic technique has become widely used since the 1970s. The basic principle of endoscopic ventriculostomy is to establish a communication between the inner and outer CSF spaces. Unlike the shunting of CSF, this technique creates a condition that approximates the physiologic circulation of CSF. Endoscopic third ventriculostomy is used mainly for the treatment of hydrocephalus caused by obstruction of the aqueduct or tumor-related obstructions. Endoscopic third ventriculostomy has also been successfully used in obstructive hydrocephalus due to cerebellar infarction. The goal is to decompress the hydrocephalus proximal to the obstructed site by creating an intracerebral pathway that bypasses the obstruction. This technique eliminates the need to introduce foreign materials into the body along with their potential complications. With its minimally invasive approach and good optical control, this method offers experienced surgeons a high success rate with low morbidity and mortality.

2.0 Anatomical Considerations

2.1 Endoscopic Instrumentation

Intracranial endoscopy requires a sophisticated endoscopic system. The GAAB neuroendoscopic system was used exclusively in the patient groups evaluated here. The system consists of rigid HOPKINS® diagnostic telescopes with five different viewing angles (see below), a rigid 6° working scope, a working sheath with obturator, a mechanical holding arm, various distancers, and a camera adapter. Intracranial endoscopy also requires special instruments for bipolar and monopolar diathermy, assorted working instruments, and a plastic irrigation catheter with adapter. Before the operation, the camera is draped in a sterile, transparent plastic cover. The telescopes are connected to the camera via a sterile adapter. During the operation, this adapter makes it easy to switch between scopes with different viewing angles while maintaining sterile conditions. The operation is documented digitally with the AIDA (Advanced Image and Data Archiving) system, a PC-based system for documenting and archiving video images and patient data. Optimum illumination is provided by a Xenon cold light source, which is connected to the endoscope by a sterile fiberoptic light cable. With their daylight spectrum (color temperature of 5600° Kelvin), Xenon cold light sources are suitable for all applications that require accurate color reproduction. A working sheath with obturator allows for scope changes and endoscopic instrument changes without collateral injury to brain tissue. The working sheath is secured in the desired position with the aid of an holding arm mounted on the operating table. Equipped with two ball-and-socket joints, the support arm is freely adjustable in all axes and allows for optimum positioning of the endoscope while allowing the surgeon to operate with both hands.

Two main types of scopes are used: diagnostic scopes and working scopes. The diagnostic scopes are rigid HOPKINS® telescopes, which are available in five different viewing angles (0°, 30°, 45°, 70°, and 120°). A color-coded ring behind the light connection indicates the viewing angle of the scope that is in use (green = 0°, red = 30°, black = 45°, yellow = 70°, white = 120°). Because the scopes are longer than the working sheath, they can provide a deeper view into the ventricle (or any other cavity) past the tip of the working sheath (e.g., through the foramen of Monro while the working sheath remains in the lateral ventricle) and will allow the surgeon to look...
through the ventriculostoma into the basal cistern while the sheath remains in the third ventricle. HOPKINS® telescopes with the same length but a smaller diameter (2.7 mm) are also available for small openings. The thinner scope can be used in a special cannulated trocar for perforating the ventricle wall under optical control, e.g., or for penetrating and dilating openings that are already present (“tracker scope,” see below). Distancers can be used to prevent uncontrolled penetration of the scope at the distal tip of the working sheath. When screwed onto the scope, the distancers prevent possible injury to brain tissue caused by advancing the scope too far. Endoscopic manipulations are performed with the 6° working scope (the 6° angle causes the instrument, which extends from the sheath alongside the scope, to appear relatively centered in the field of view at the surgical site). The working scope has a 1.7-mm diameter and, unlike the diagnostic scopes, is equipped with two light-conducting rods instead of circumferential optical fibers. This gives the working scope a kidney-shaped cross section with the instrument(s) in the center. This arrangement makes maximum use of the luminal volume of the working sheath while allowing for precise instrument guidance. It leaves sufficient space within the sheath for the working channel through which endoscopic instruments are introduced. An introduction cone is an attachable accessory that facilitates the use and accurate guidance of instruments. Another introduction cone is also available with two lumina through which two 1.3-mm rigid instruments can be simultaneously inserted, e.g., for holding a membrane during cutting or for performing bimanual dissection.

Available working instruments include a variety of graspers and scissors. Both bipolar and monopolar diathermy can be used for hemostasis. For Endoscopic third ventriculostomy a special ventriculostomy forceps is used which has external ridges designed to keep the perforated membrane from slipping during dilation. The dilation is therefore very precise according to the opening of this instrument-i.e., horizontal in case of a ventriculostomy, thus away from the basilar artery and its branches. The stoma can also be safely dilated with a 3 or 4 French balloon catheter, and a soft membrane can even be punctured atraumatically with the blunt tip of the soft balloon. The ventricle or other cavity system requiring inspection can be irrigated if necessary with an irrigation catheter introduced into the working sheath through a side port. The ability to place the irrigation catheter close to a bleeding site is particularly useful. Since the “point irrigation” quickly clears away blood without clouding and discoloring the CSF, even a heavy bleeding site can be accurately coagulated during constant irrigation. This is better than diffuse sheath irrigation for identifying a brisk bleeding site and obtaining point hemostasis. Also, an adapter is available for connecting a large syringe for manual irrigation, which may be used as an adjunct to continuous irrigation. Irrigation is performed with Ringer solution warmed to body temperature. The Clearvision® lens irrigation system, which is driven by a roller pump (KARL STORZ), can be used in situations that require continuous irrigation with Ringer solution.
HOPKINS® wide-angle 6° forward-view telescope with angled eyepiece, length 15 cm, autoclavable, with integrated optical fibers (rods) and a 3-mm-diameter working channel (KARL STORZ 28096 AGA).

HOPKINS® wide-angle 6° forward-view telescope, inserted into the operating sheath (28162 BS) and mounted on the holding system (28272 KKA).

HOPKINS® wide-angle 6° forward-view telescope, oblique view, with 3-mm-diameter instrument channel (28096 AGA)

Operating sheath, outer diameter 6.5 mm (28162 BS)

Biopsy forceps, 1.7 mm (28162 Z)

HOPKINS® wide-angle 0° forward-view telescope, 4 mm diameter, angled eyepiece (28162 AVA);

Irrigation Sheath, Ø 4.8 mm (28162 AVS).

Grasping forceps, 1.7 mm diameter (28162 P)

Scissors, blunt/blunt, 1.7 mm diameter (28162 ES)

Scissors, pointed/blunt, 1.7 mm diameter (28162 EK)

Grasping forceps, 2.7 mm diameter (28162 U)

Biopsy forceps, 2.7 mm diameter (28162 ZE)

Distal end of the operating sheath. The light guides and telescope are housed in a stable kidney-shaped capsule.
2.2 Technique of Endoscopic Third Ventriculostomy for Standard Indications

The standard technique for endoscopic third ventriculostomy, as established by M. R. Gaab, will be described below for a hypothetical patient with obstructive hydrocephalus due to aqueductal stenosis (Fig. 1). Congenital or acquired aqueductal stenosis is a common indication for endoscopic third ventriculostomy. The procedure is usually performed under general endotracheal anesthesia. The patient’s head is immobilized in a Mayfield three-pin head clamp in a slightly anteflexed position. We do not use a pin clamp on small children up to 1 year of age, preferring instead to immobilize the head with adhesive tape passed over the forehead. Finally the operative area is sterily washed and draped. For a standard endoscopic third ventriculostomy, a burr hole is placed approximately 2 cm anterior to the coronal suture and 2 cm lateral to the midline (Fig. 2a, b). In difficult anatomical situations such as relatively small ventricles or asymmetries, neuronavigation can aid in planning a precise surgical approach. Besides the targeted site, particular attention should be given to negotiating obstacles such as the foramen of Monro without causing injury.

The scalp is opened with a straight skin incision approximately 3 cm long, and the skull is opened with a 10-mm burr hole. The dura is incised, and the lateral ventricle is punctured with the working sheath and obturator using freehand technique.

Finally the working sheath at secured in the holding arm at a depth of approximately 5 cm to a maximum of 6 cm past the level of the dura and burr hole, depending on ventricular size. The maximum safe depth is measured on preoperative CT or MR images, aided by neuronavigational guidance in anatomically difficult cases. Current neuronavigation systems have options for measuring the optimum dimensions for the puncture sheath as well as the scopes of all established neuroendoscopy systems.

The obturator is removed, and a rigid 0° diagnostic scope is introduced into the working sheath after first adjusting the white balance of the endoscopic camera. (Caution: introduce the scope slowly under visual guidance or use a distancer that will keep the scope tip from plunging past the distal end of the sheath, with risk of injury). The lateral ventricle is inspected, and key landmarks such as the foramen of Monro, choroid plexus, and fornix are identified (Fig. 3) using 30° to 120° diagnostic scopes. The 45° scope can provide a 360° visual sweep of the cavity by rotating the scope once on its longitudinal axis. As this is done, the camera remains in the anatomically correct position while the telescope is rotated in the camera adapter to provide a stable view. The 120° scope can even provide a “backward” view, as in cases where the tip of the scope is in the third ventricle and the surgeon wishes to confirm the complete resection of a colloid cyst. If vision is poor due to turbid or bloody CSF, an irrigation system such as Clearvision® can be activated until clear visibility is restored.
The working sheath is advanced through the foramen of Monro into the third ventricle under visual control and secured in that position. Care is taken to preserve the fornix, which is part of the limbic system. The scope (generally the 0° diagnostic scope) is withdrawn until the edge of the sheath can be advanced into the third ventricle without scraping the foramen of Monro and especially without injuring the fornix. The sheath, which has a relatively sharp tip, should never be moved without optical control! If the foramen of Monro is relatively small and there are no large veins that would pose a bleeding risk, it may be necessary to gently displace the posterior rim of the foramen (plexus) posteriorly to avoid injuring the delicate fornix on the anterior side. At this point the mamillary bodies and infundibular recess can be identified on the floor of the third ventricle (Fig. 4). After the third ventricle has been inspected, the diagnostic scope is replaced by the 6° working scope. Using bipolar diathermy, the floor of the third ventricle is coagulated and bluntly perforated at the site of the proposed ventriculostomy (Fig. 5). That point is located in the midline, midway between the infundibular recess and mamillary bodies. The location of the clivus determines the direction of the perforation – which should aim just behind the clivus and thus anterior to the basilar artery and its branches. If the floor of the third ventricle is relatively thick, the surgeon may be able to feel the clivus and then place the perforation behind it. The stoma is first enlarged with the ventriculostomy forceps (Fig. 6) and then dilated to its definitive size with a balloon catheter passed into the stoma (Fig. 7).
Minor bleeding at the stoma site can generally be coagulated with bipolar diathermy or compressed with the balloon catheter without any difficulty. When the ventriculostomy has been completed, the working scope is replaced by the 0° or 30° diagnostic scope. These are used to assess the completed ventriculostomy and identify the dorsum sellae and the tip of the basilar artery in the prepontine cistern. If a Liliequist membrane has been identified, it is also opened to ensure that a functioning communication is established with the prepontine cistern (Figs. 8a–c). Finally the working sheath with the 0° diagnostic scope is withdrawn under visual control back through the foramen of Monro and out of the cerebral cortex. Attention is given at this time to any bleeding sites that may be encountered in the fornix region and cortex (Fig. 9). An external ventricular drain is inserted only if the success of the ventriculostomy is in doubt, e.g., following an intracerebral hemorrhage or if the CSF is very bloody due to difficult hemostasis. A piece of Gelfoam is placed into the burr hole, and the wound is tightly closed in layers to prevent a CSF leak. The skin is closed with a continuous nonabsorbable suture line.

3.0 Anatomical Aspects of Endoscopic Third Venticulostomy for Rare Causes of Obstructive Hydrocephalus

3.1 Patient Groups and Clinical Evaluation

From May 1993 to June 2008, more than 500 patients with intracranial pathologies underwent endoscopic surgery at the Department of Neurosurgery of Greifswald University Hospital (May 1993 to February 2003) and at the Department of Neurosurgery of Nordstadt Hospital, Hannover Regional Medical Center (February 2003 to June 2008). This series included 62 endoscopic third ventriculostomies that were performed in patients with rare causes of obstructive hydrocephalus. Twenty of the cases were due to obstruction of CSF flow from the fourth ventricle, 39 cases were due to...
intracerebral hemorrhage, and three cases were due to obstruction by a giant basilar artery aneurysm.

A common feature in all cases was that the lesion was sufficient to cause obstructive hydrocephalus. An endoscopic third ventriculostomy was done purely to relieve the CSF flow obstruction rather than treat the underlying cause, which is sometimes possible with ventricular tumors. The operating technique was basically the same as described for a standard ventriculostomy. The patients were evaluated clinically for neurologic signs of increased intracranial pressure such as headache, nausea, vomiting, and visual disturbances. Attention was also given to vigilance level, head circumference, and possible retardation. Pre- and postoperative images were evaluated for morphologic signs of chronic, subacute or acute hydrocephalus. Cranial MRI, the gold standard for hydrocephalus imaging, permitted a detailed analysis of ventricular morphology, the cause of the CSF obstruction, and the underlying pathology. The configuration of the cerebral ventricles was analyzed with regard to global or partial dilatation of the ventricular system and the morphology of the third ventricle (bulging of the lamina terminalis and ventricular floor) that would signify increased intraventricular pressure. In cases where cranial MRI was not performed (e.g., due to a cardiac pacemaker), the patients were evaluated by cranial computed tomography. The CT scans were analyzed for the presence of hydrocephalus, the site of the obstruction, and the extent and location of the underlying pathology.

### 3.2 Endoscopic Third Ventriculostomy for Obstruction of CSF Flow from the Fourth Ventricle

In the 20 patients who had obstruction of CSF flow from the fourth ventricle, the cause of the obstruction was a Dandy-Walker malformation in 13 cases and an Arnold-Chiari malformation in 3 cases. One patient had an obstruction of CSF flow in the posterior cranial fossa distal to the fourth ventricle, two patients had posthemorrhagic hydrocephalus, one had postmeningitic hydrocephalus, and one patient had arachnopathy due to neurofibromatosis. All the patients underwent preoperative cranial MRI, which showed dilatation of the ventricular system in all 20 patients.
Endoscopic Third Ventriculostomy for Rare Causes of Obstructive Hydrocephalus

Illustrative clinical cases with intraoperative findings (Figs. 10–13)

Figures 10–13c show preoperative cranial MR images along with endoscopic image sequences that illustrate the course of the operation. The patient is a 50-year-old woman who was admitted to the Neurology Department at Nordstadt Hospital for visual deterioration without papilledema. In the past, the patient had been a victim of violent crime and had sustained severe head trauma. Endoscopic third ventriculostomy was performed without complications. The patient subsequently reported a subjective decline of visual acuity over time.

View into the lateral ventricle with the rigid 0° diagnostic scope. The greatly thinned septum pellucidum and enlarged foramen of Monro are evidence of longstanding hydrocephalus.

Third ventricle viewed through the foramen of Monro with the rigid 0° diagnostic scope. The floor of the third ventricle appears thinned and transparent.

Floor of the third ventricle viewed with the 0° diagnostic scope. The mamillary bodies are displaced far laterally as a sign of chronic hydrocephalus.
Endoscopic Third Ventriculostomy for Rare Causes of Obstructive Hydrocephalus

**12a**
Floor of the third ventricle, viewed through the working scope at high magnification.

**12b**
Bipolar diathermy probe is introduced into the third ventricle through the instrument channel of the working scope. The proposed ventriculostomy site is coagulated.

**12c**
The completed third ventriculostomy viewed through the 0° diagnostic scope.

**12d**
View through the ventriculostomy into the prepontine cistern with the 0° diagnostic scope.

**13a**
View of the aqueduct with the flexible neurofiberscope.

**13b**
View into the fourth ventricle with the neurofiberscope. An obstructive membrane is visible at the foramen of Magendi.

**13c**
Future ventriculostomy site in the midline, midway between the infundibular recess and basilar artery.

**13d**
Postoperative sagittal T2-weighted cranial MRI demonstrates a patent ventriculostomy.
3.3 Endoscopic Third Ventriculostomy for Obstruction Caused by Intracerebral Hemorrhage

Of the 39 patients who underwent endoscopic ventriculostomy at the neurosurgical departments of Greifswald University Hospital and Nordstadt Hospital between May 1993 and June 2008, the cause of the obstruction in 21 patients was a cerebellar hemorrhage. Six patients had a thalamic hemorrhage, four had a third ventricular hemorrhage, three had bleeding localized mainly in the fourth ventricle, three had a basal ganglia hemorrhage, one had a pontine hemorrhage, and one had a cerebellopontine angle hemorrhage. In 34 cases the hemorrhage ruptured into the ventricular system. The causes were hypertensive hemorrhage in 31 cases, a bleeding cavernoma in two cases, and one patient each had traumatic, postoperative, aneurysmal, or angiomatous bleeding. One patient had multiple intracerebral hemorrhages, an infarction being the most likely cause.

Illustrative clinical cases with intraoperative findings (Figs. 14 – 16)

The figures below show pre- and postoperative cranial MR images along with endoscopic image sequences that illustrate the intraoperative findings. The patient is a 76-year-old man who presented with nausea and dizziness of acute onset. Endoscopic third ventriculostomy was performed without complications. The patient made a good recovery and no further neurologic deficits occurred.

Cranial computed tomography without contrast medium shows a ventricular system obstructed by blood clots. Cranial computed tomography without contrast medium. The fourth ventricle is completely occluded by blood clots.
A balloon catheter is introduced into the ventriculostomy through the instrument channel of the working scope. The lateral ventricle and foramen of Monro viewed with the 0° diagnostic scope. The CSF is clouded by intraventricular hemorrhagic involvement, indicating a need for continuous ventricular irrigation.

The CSF has been cleared by extensive irrigation.

A balloon catheter is introduced into the ventriculostomy through the instrument channel of the working scope.

The completed ventriculostomy.

View through the 0° diagnostic scope into the prepontine cistern.

Postoperative CT after endoscopic third ventriculostomy no longer shows dilatation of the inner CSF spaces.
Endoscopic Third Ventriculostomy for Rare Causes of Obstructive Hydrocephalus

4.0 Results and Conclusion

From May 1993 to June 2008, more than 500 patients underwent endoscopic surgery at the neurosurgical departments of Greifswald University Hospital and Nordstadt Hospital in Hannover. Sixty-two patients had a rare cause of obstructive hydrocephalus. The underlying cause in 20 patients was an obstruction of CSF flow from the fourth ventricle. 39 patients had an intracerebral hemorrhage with or without intraventricular involvement, and a giant basilar artery aneurysm was causative in three patients.

All of the patients received a clinical neurologic evaluation before and after the operation. The progression of pre- and postoperative ventricular size was also analyzed on the basis of cranial CT or MR images. Besides the clinical neurologic findings and changes in cranial imaging features, the intraoperative findings were documented and evaluated in all patients.

In cases where obstructive hydrocephalus was caused by obstructed CSF flow from the fourth ventricle, the site of the obstruction was located far distally in the fourth ventricle. This type of condition is a rare cause of obstructive hydrocephalus. All the patients manifested typical signs and symptoms of chronic obstructive hydrocephalus. An endoscopic third ventriculostomy was successfully performed in all cases. Transaqueductal inspection of the fourth ventricle was possible in 16 cases to confirm the cause of the obstruction. The endoscopic procedure was clinically successful in 75% of the cases. Ventricular size was regressive in 50% of cases. Twenty-five percent of the patients required the subsequent implantation of a shunt system. Complications consisted of one clinically insignificant fornix contusion and one CSF leak. The morbidity rate was 0%.
39 patients underwent endoscopic third ventriculostomy for obstructive hydrocephalus caused by an intracerebral hemorrhage with or without intraventricular involvement. Preoperative neurologic examination showed reduced vigilance in 97% of the patients. The hemorrhage had ruptured into the ventricular system in 87% of the patients. As a result, blood clots had to be removed endoscopically in 41% of the patients in order to reach the floor of the third ventricle. 51% of the patients showed clinical improvement after the operation, and imaging findings were noted to be improved in 61% of cases. There was no morbidity or mortality referable to the surgical procedure. A total of 13 patients died during their hospital stay or during postoperative follow-up. 46% of the patients showed permanent clinical improvement, while two patients required shunt implantation.

Obstructive hydrocephalus caused by a giant basilar artery aneurysm is a very rare clinical occurrence. All three patients exhibited the typical signs and symptoms of subacute hydrocephalus. An endoscopic third ventriculostomy was performed without complications in each case. Preoperative symptoms resolved completely in all three patients, and imaging changes confirmed successful completion of the ventriculostomy.

Thus, besides the more common indications for endoscopic third ventriculostomy such as aqueductal stenosis, this procedure is also a valid treatment option for rare causes of obstructive hydrocephalus as described above. It is a safe and cost-effective alternative to the implantation of a shunt system. Additionally, it reduces the risk of infection that may result from shunt implantations and shunt revisions.
Sagittal T2-weighted cranial MRI shows an Arnold-Chiari malformation with evidence of chronic hydrocephalus.

Axial T2-weighted cranial MRI shows evidence of a hydrocephalic process. The foramina of Monro are unusually small.

View into the right lateral ventricle through the standard 0° diagnostic scope. The choroid plexus appears atrophied due to the chronic pressure elevation in obstructive hydrocephalus.

Inspection with the standard 30° diagnostic scope clearly shows a perforation of the septum pellucidum due to the chronic pressure elevation.

5.0 Endoscopic Third Ventriculostomy with the GAAB Neuroscope

Scopes with an outer sheath diameter of approximately 6.5 mm are used routinely owing to their excellent optical quality and maneuverability. In more than 20 years of experience, the senior author (MRG) has found this to be the minimum diameter for effective endoscopic manipulations while still being able to negotiate narrow passages like the foramen of Monro. Occasionally, however, initial ventriculoscopy will reveal limiting anatomical factors, such as a very small foramen of Monro, that would make it difficult to use the working scope described in the cases above. Barring the need for complex methods of hemostasis or endoscopic manipulation, the mini-fiber scope (GAAB “pediatric” neuroscope) can be a useful tool in these anatomically challenging cases. With an outer sheath diameter of 4.5 mm and a resolution of 35,000 pixels, this instrument is less invasive than the standard scope and provides higher image quality than a flexible fiberscope. The GAAB neuroscope can be used with a matched set of rigid working instruments (rigid for more accurate control) to perform punctures, ventriculostomies (special 1.3-mm ventriculostomy forceps), cystostomies, septostomies, biopsies, and monopolar diathermy. An ordinary balloon catheter (2 Fr.) can be used. Besides the instrument channel, the GAAB neuroscope has two irrigation channels, each 1.15 mm in diameter, to provide access for introducing flexible 1-mm instruments.

Illustrative clinical case with intraoperative findings (Figs. 19–32)

The intraoperative images presented below illustrate an endoscopic third ventriculostomy performed with the GAAB mini-fiber scope. The patient is a 36-year-old woman who complained of visual disturbance, especially in the right eye, that had been present for approximately 3 weeks. Optic fundus examination revealed bilateral chronic papilledema. The patient was found to have an underlying Arnold-Chiari malformation that had not been previously diagnosed. An uncomplicated ventriculostomy was performed. The patient reported subjective visual improvement within a few days after the operation.
Despite chronic pressure exposure, the foramen of Monro is markedly small and tight. It is too small to admit the standard working sheath.

After switching to the mini-fiber scope (GAAB II), the thinner working sheath passes through the foramen to visualize the floor of the third ventricle.

The floor of the ventricle is bluntly perforated with the ventriculostomy forceps.

The stoma is dilated with a balloon catheter.

Completed stoma in the floor of the third ventricle.

Inspection of the preptontine cistern. The edge of the clivus and the basilar artery can be identified.
Endoscopic Third Ventriculostomy for Rare Causes of Obstructive Hydrocephalus

No cortical bleeding is seen during removal of the working sheath.

A membranous occlusion of the foramen of Magendi is visible at the outlet of the fourth ventricle.

Postoperative sagittal T2-weighted cranial MRI shows a flow void sign above the ventriculostomy, indicating the restoration of CSF flow.

GAAB II 0° neuroscope with 35,000 pixel resolution (outer diameter 3.8 mm, working length 21 cm, autoclavable) with operating sheath (outer diameter 4.5 mm) (KARL STORZ 28162 AMA and 28162 CS).
References

Endoscopic Third Ventriculostomy for Rare Causes of Obstructive Hydrocephalus

Neuro-Endoscopy – Intracranial Surgery
Basic Set
Neuro-Endoscopy – Intracranial Surgery

Basic Set

GAAB Recommended Set for Neuro-Endoscopy

Telescopes and Sheaths

1. 28096 AGA HOPKINS® Wide Angle Straight Forward Telescope 6°, angled eyepiece, length 15 cm, autoclavable, with fiber optic light transmission and working channel diameter 3 mm incorporated, robust version, color code: green
2. 28162 BS Operating Sheath, graduated, outer diameter 6.5 mm, working length 13 cm, with lateral stopcock and catheter port
3. 28162 BO Obturator, for use with Operating Sheath 28162 BS

Instruments

4. 28162 U Grasping Forceps, single action jaws, diameter 2.7 mm, working length 30 cm
5. 28162 ZE Biopsy Forceps, single action jaws, diameter 2.7 mm, working length 30 cm
6. 28162 EP Scissors, pointed, single action jaws, diameter 2.7 mm, working length 30 cm
7. 28162 EM Scissors, pointed, slightly curved, double action jaws, diameter 1.7 mm, working length 30 cm
8. 28162 Z Biopsy Forceps, double action jaws, diameter 1.7 mm, working length 30 cm
9. 28160 TVX Forceps, for ventriculostomy, double action jaws, diameter 1.7 mm, working length 30 cm
10. 28162 BDL TAKE-APART® Bipolar Forceps, with flat jaws, size 2.4 mm, working length 24 cm

   including:
   - Bipolar Ring Handle
   - Outer Sheath
   - Working Insert, for single use, package of 5
   - 28762 KB Bipolar Coagulation Electrode, diameter 1.7 mm, working length 30 cm
   - 28762 K Coagulation Electrode, unipolar, semiflexible, diameter 1.7 mm, working length 30 cm
   - 533 TVA Adaptor, autoclavable, permits telescope changing under sterile conditions

Holding System

11. 28272 KKA Holding System, autoclavable

   including:
   - Socket, to clamp to the OR table
   - Articulated Stand, straight
   - Clamping Jaw, metal, with axial uptake

Optional

12. 28162 BB Obturator, with central hole 2 mm for stereotactic positioning, for use with Operating Sheath 28162 BS
13. 28162 BD Optical Obturator, for positioning Operating Sheath 28162 BS under visual control, for use with HOPKINS® Telescope 28018 AA
14. 28018 AA HOPKINS® Straight Forward Telescope 0°, diameter 2.7 mm, length 18 cm, autoclavable, fiber optic light transmission incorporated, color code: green

For Diagnosis

15. 28132 AA HOPKINS® Straight Forward Telescope 0°, enlarged view, diameter 4 mm, length 18 cm, autoclavable, fiber optic light transmission incorporated, color code: green
16. 28132 BWA HOPKINS® Wide Angle Forward-Oblique Telescope 30°, enlarged view, diameter 4 mm, length 18 cm, autoclavable, fiber optic light transmission incorporated, color code: red
17. 28132 FA HOPKINS® Forward-Oblique Telescope 45°, enlarged view, diameter 4 mm, length 18 cm, autoclavable, fiber optic light transmission incorporated, color code: black
18. 28162 EA Telescope Bridge, for use with HOPKINS® Telescope 28132 AA through Operating Sheath 28162 BS
19. 28162 E Telescope Bridge, for use with HOPKINS® Telescope 28132 BA/BWA/CA/FA through Operating Sheath 28162 BS

Recommended containers for sterilization:

Telescopes: 39301 A (3x)
Angled eyepiece: 39314 G
Instruments: 39360 BK

It is recommended to check the suitability of the product for the intended procedure prior to use.
Endoscopic Third Ventriculostomy for Rare Causes of Obstructive Hydrocephalus

Neuro-Endoscopy – Intracranial Surgery
GAAB Recommended Set for Pediatric Neurosurgery
Neuro-Endoscopy – Intracranial Surgery

**GAAB Recommended Set for Pediatric Neurosurgery**

1. 28162 AMA  **GAAB Neuroscope 0°**, fiber optic transmission guide 35,000 pixels, outer diameter 3.8 mm, working length 21 cm, **autoclavable**, for use with Operating Sheath 28162 CS
2. 28162 CS  **Sheath**, graduated, outer diameter 4.5 mm, working length 20 cm, with blunt Obturator 28162 CSO
3. 28160 KA  **Coagulating Electrode**, unipolar, flexible, diameter 1 mm, working length 53 cm
4. 11161 KA  **Biopsy Forceps**, double action jaws, flexible, diameter 1 mm, working length 60 cm
5. 11161 KB  **Grasping Forceps**, double action jaws, flexible, diameter 1 mm, working length 60 cm
6. 28160 EK  **Scissors**, single action jaws, diameter 1.3 mm, working length 30 cm
7. 28162 FL  **Biopsy Forceps**, double action jaws, semirigid, diameter 1.3 mm, working length 30 cm
8. 28161 SG  **Grasping Forceps**, double action jaws, semirigid, diameter 1.3 mm, working length 30 cm
9. 28160 TVL  **Forceps**, for ventriculostomy, flexible, diameter 1 mm, working length 60 cm (not illustrated)

**Recommended container for sterilization:**

Angled Eyepiece: 39501 XKN
Instruments: 39560 AK
Neuroscope
Operating Sheath, outer diameter 6.5 mm

GAAB Recommended Set

- For diagnostic orientation in the ventricular system, the cerebellopontine angle, basal cisterns, for arachnoidal cysts, for cystic intracranial tumors
- For therapeutic ventriculostomy, catheterization of the aquaeductus and removal of cysts, tumors and other occlusions in the ventricular region

**HOPKINS® Wide Angle Straight Forward Telescope 6°**, angled eyepiece, length 15 cm, autoclavable, with fiber optic light transmission and working channel diameter 3 mm incorporated, robust version, color code: green

**Operating Sheath**, outer diameter 6.5 mm, working length 13 cm, graduated, with lateral stopcock and catheter port

**Obturator**, for 28162 BS, with central hole 2 mm for stereotactic positioning

**Optical Obturator**, for positioning Operating Sheath 28162 BS under visual control, for use with HOPKINS® Telescope 28018 AA

**Obturator**, for 28162 BS

**HOPKINS® Straight Forward Telescope 0°**, diameter 2.7 mm, length 18 cm, autoclavable, fiber optic light transmission incorporated, color code: green
Operating Instruments

GAAB Recommended Set, for use with HOPKINS® Telescope 28096 AGA and Operating Sheath 28162 BS

Diameter 2.7 mm, working length 30 cm

28162 EP  Scissors, pointed, single action jaws, diameter 2.7 mm, working length 30 cm
28162 EH  Hook Scissors, single action jaws, diameter 2.7 mm, working length 30 cm
28162 DH  Biopsy Punch Forceps, through-cutting, single action jaws, diameter 2.7 mm, working length 30 cm
28162 U   Grasping Forceps, single action jaws, diameter 2.7 mm, working length 30 cm
28162 ZE  Biopsy Forceps, single action jaws, diameter 2.7 mm, working length 30 cm
Operating Instruments

GAAB Recommended Set, for use with HOPKINS® Telescope 28096 AGA and Operating Sheath 28162 BS

Diameter 1.7 mm, working length 30 cm

28162 P

28160 TVX Forceps, for ventriculostomy, flexible, diameter 1.7 mm, working length 30 cm

28162 F Grasping Forceps, double action jaws, diameter 1.7 mm, working length 30 cm

28162 Z Biopsy Forceps, double action jaws, 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

28162 EK Scissors, pointed/blunt, single action jaws, diameter 1.7 mm, working length 30 cm

28162 ES Scissors, blunt/blunt, single action jaws, diameter 1.7 mm, working length 30 cm

28762 K Coagulating Electrode, unipolar, semiflexible, diameter 1.7 mm, working length 30 cm

28762 KB Bipolar Coagulating Electrode, diameter 1.7 mm, working length 30 cm

28162 SN Irrigation Tube, autoclavable, with Luer-Lock connection

28162 BDL

28162 BDL TAKE-APART®

Bipolar Grasping Forceps, flat jaws, size 2.4 mm, length 26 cm including:

Handle
Outer Sheath
Working Insert, package of 5, disposable
Diagnostic Telescopes for Neuroscope
HOPKINS® Telescopes, Telescope Bridges

GAAB Recommended Set
for use with Operating Sheath 28162 BS

Diameter 4 mm, length 18 cm

28132 AA  HOPKINS® Straight Forward Telescope 0°,
enlarged view, diameter 4 mm, length 18 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: green

28162 EA  Telescope Bridge,
for use with HOPKINS® Telescope 28132 AA
through Operating Sheath 28162 BS

28132 BWA  HOPKINS® Wide Angle Forward-Oblique Telescope 30°,
enlarged view, diameter 4 mm, length 18 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: red

28132 FA  HOPKINS® Forward-Oblique Telescope 45°,
enlarged view, diameter 4 mm, length 18 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: black

28132 CA  HOPKINS® Lateral Telescope 70°,
enlarged view, diameter 4 mm, length 18 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: yellow

28162 E  Telescope Bridge,
for use with HOPKINS® Telescope 28132 BA/BWA/CA/FA
through Operating Sheath 28162 BS

533 TVA  Adaptor, autoclavable,
permits telescope changing under
sterile conditions
Pediatric Neuroscope
Operating Sheath, outer diameter 4.5 mm

Special Features:
- Fiber optic system in proven quality
- Suitable for pediatric interventions
- The physician has both hands free for operating the instruments
- Large inflow – two separate irrigation channels with diameter of 1 mm for continuous suction and irrigation

- Central working channel with a diameter of 1.3 mm allows use of rigid instruments
- Lateral irrigation channel allows use of additional instruments with a diameter of 1 mm parallel to the working channel
- Autoclavable

28162 AMA

28162 CS Sheath, graduated, outer diameter 4.5 mm, working length 20 cm, with blunt Obturator 28162 CSO
Accessories for the Pediatric Neuroscope
Instruments – rigid and flexible

Rigid instruments for use through the central channel, diameter 1.3 mm, working length 30 cm

Biopsy Forceps, double action jaws, semirigid, diameter 1.3 mm, working length 30 cm

Grasping Forceps, double action jaws, semirigid, diameter 1.3 mm, working length 30 cm

Scissors, single action jaws, semirigid, diameter 1.3 mm, working length 30 cm

Flexible instruments for use through the lateral channel, diameter 1 mm, working length 60/53 cm

Forceps, for ventriculostomy, flexible, diameter 1 mm, working length 60 cm
Endoscopic Third Ventriculostomy for Rare Causes of Obstructive Hydrocephalus

**IMAGE1 S Camera System**

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

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

**Dashboard**

**Live menu**

**Intelligent icons**

**Side-by-side view:** Parallel display of standard image and Visualization mode
Endoscopic Third Ventriculostomy for Rare Causes of Obstructive Hydrocephalus

IMAGE1 S Camera System

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

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

FULL HD image

CLARA

FULL HD image

CHROMA

FULL HD image

SPECTRA A*

SPECTRA B**

* SPECTRA A: Not for sale in the U.S.
** SPECTRA B: Not for sale in the U.S.
TC 200EN

**IMAGE1 S Camera System**

**TC 200EN**

**IMAGE1 S CONNECT**, connect module, for use with up to 3 link modules, resolution 1920 x 1080 pixels, with integrated KARL STORZ-SCB and digital Image Processing Module, power supply 100–120 VAC/200–240 VAC, 50/60 Hz including:

- **Mains Cord**, length 300 cm
- **DVI-D Connecting Cable**, length 300 cm
- **SCB Connecting Cable**, length 100 cm
- **USB Flash Drive**, 32 GB, USB silicone keyboard, with touchpad, US

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

**Specifications:**

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

**For use with IMAGE1 S**

**IMAGE1 S CONNECT Module TC 200EN**

**TC 300**

**IMAGE1 S H3-LINK**, link module, for use with IMAGE1 FULL HD three-chip camera heads, power supply 100–120 VAC/200–240 VAC, 50/60 Hz, for use with **IMAGE1 S CONNECT TC 200EN** including:

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

**Specifications:**

<table>
<thead>
<tr>
<th>Camera System</th>
<th>TC 300 (H3-Link)</th>
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<tbody>
<tr>
<td>Supported camera heads/video endoscopes</td>
<td>TH 100, TH 101, TH 102, TH 103, TH 104, TH 106 (fully compatible with IMAGE1 S)</td>
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<tr>
<td></td>
<td>222200055-3, 222200056-3, 222200053-3, 222200060-3, 222200061-3, 222200054-3, 222200055-3 (compatible without IMAGE1 S technologies CLARA, CHROMA, SPECTRA*)</td>
</tr>
<tr>
<td>LINK video outputs</td>
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<td>Power supply</td>
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<tr>
<td>Power frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Protection class</td>
<td>I, CF-Defib</td>
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<tr>
<td>Dimensions w x h x d</td>
<td>305 x 54 x 320 mm</td>
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<tr>
<td>Weight</td>
<td>1.86 kg</td>
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</tbody>
</table>

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

Direct Adaption

With the operating microscope the surgeon always has a perfect view of the operating field. Assistents, OR nurses and students, however, often experience poor video presentation, especially if FULL HD visualization is not available.

KARL STORZ offers a one-stop-shop solution to upgrade any surgical microscope with state-of-the-art FULL HD imaging technology. To achieve optimal results, all components in the video chain – from the camera system to the monitor – must be of the highest quality.

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

Here the H3-M COVIEW microscope camera and the corresponding QUINTUS® TV adaptor are directly connected to the microscope via the C-MOUNT connection.
IMAGE1 S Camera Heads

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

TH 106

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

20 2001 31

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

Specifications:

<table>
<thead>
<tr>
<th>IMAGE1 S FULL HD Camera Heads</th>
<th>IMAGE1 S H3-M COVIEW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product code</td>
<td>TH 106</td>
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<tr>
<td>Image sensor</td>
<td>3x ( \frac{1}{3} )&quot; CCD chip</td>
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<tr>
<td>Dimensions w x h x d</td>
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<td>Weight</td>
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<td>Optical interface</td>
<td>C-MOUNT connection</td>
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<tr>
<td>Min. sensitivity</td>
<td>F 1.9/1.4 Lux</td>
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<tr>
<td>Grip mechanism</td>
<td>C-MOUNT connection</td>
</tr>
<tr>
<td>Cable</td>
<td>detachable</td>
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<tr>
<td>Cable length</td>
<td>900 cm</td>
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</tbody>
</table>
HD Imaging with Operating Microscope

System Components

QUINTUS® – High-Performance TV Adaptor for Operating Microscopes

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

The new QUINTUS® TV adaptor is the perfect interface between the operating microscope and the H3-M COVIEW FULL HD microscope camera head from KARL STORZ.

The innovative features of QUINTUS® are easy to use, making it one of the most flexible TV adaptors on the market.

Product Features:

- A rotating C-MOUNT connection at the QUINTUS® TV adaptor allows immediate adaption of the camera orientation during mounting.
- The focus control makes it possible to easily achieve parfocality (perfectly sharp camera and microscope images).
- The iris control provides convenient and optimal adjustment of the depth of field.
- Pan (X) function enables adjustment of the horizontal position of the camera image.
- Tilt (Y) function enables adjustment of the vertical position of the camera image. The pan and tilt functions help the surgeon to adjust the position of the camera image according to his individual needs.
- The QUINTUS® ZOOM model also features a variable focal length $f = 43–86$ mm. This allows the surgeon greater flexibility in choosing the exact zone required for documentation.

Focal length of the QUINTUS® TV adaptor:

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

Focal lengths: H3-M COVIEW camera image detail using a QUINTUS® TV adaptor with the fixed focal lengths of 45 and 55 mm.

Variable focal length: Adjustable H3-M COVIEW camera image detail using a QUINTUS® zoom adaptor with variable focal length of 43–86 mm.
HD Imaging with Operating Microscope

System Components

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

20923045 QUINTUS® Z 45 TV Adaptor, for CARL ZEISS MEDITEC operating microscopes, \( f = 45 \) mm, recommended for IMAGE1 HD H3-M/H3-M COVIEW camera heads

20923055 QUINTUS® Z 55 TV Adaptor, for CARL ZEISS MEDITEC operating microscopes, \( f = 55 \) mm, recommended for IMAGE1 HD H3-M/H3-M COVIEW, H3, H3-Z as well as IMAGE1 S1 and S3 camera heads

20923045/20923055

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

20923000 Z QUINTUS® Zoom TV Adaptor, for CARL ZEISS MEDITEC operating microscopes, with variable focal length \( f = 43–86 \) mm, for use with all KARL STORZ cameras (SD and HD)

20923000 Z

Further accessories for operating microscopes from CARL ZEISS MEDITEC

20925000 Iris, for ZEISS Pentero®, iris as a necessary extension between the QUINTUS® TV adaptor and the operating microscope ZEISS Pentero®

20925000

301513 Optical Beamsplitter 50/50, for use with ZEISS operating microscope or colposcope

301513

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

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

20933045  QUINTUS® L 45 TV Adaptor, for LEICA Microsystems operating microscopes, f = 45 mm, recommended for H3-M microscope camera head

20933055  QUINTUS® L 55 TV Adaptor, for LEICA Microsystems operating microscopes, f = 55 mm, recommended for IMAGE1 HD H3-M/H3-M COVIEW, H3, H3-Z as well as S1 and S3 camera heads

20 9330 45/20 9330 55

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

20933000 Z  QUINTUS® Zoom TV Adaptor, for LEICA Microsystems operating microscopes, with variable focal length f = 43–86 mm, for use with all KARL STORZ cameras (SD and HD)

20 9330 00 Z

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

20953045  QUINTUS® M 45 TV Adaptor, for Möller-Wedel operating microscopes, f = 45 mm, recommended for IMAGE1 HD H3-M/H3-M COVIEW camera heads

20953055  QUINTUS® M 55 TV Adaptor, for Möller-Wedel operating microscopes, f = 55 mm, recommended for IMAGE1 HD H3-M/H3-M COVIEW, H3, H3-Z and S1, S3 camera heads

20 9530 45/20 9530 55

Note: Optical beamsplitters for other operating microscopes (i.e. LEICA or Möller-Wedel) are available directly from the manufacturers.
Endoscopic Third Ventriculostomy for Rare Causes of Obstructive Hydrocephalus

IMAGE1 S Camera Heads

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

TH 100

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

Specifications:

<table>
<thead>
<tr>
<th>IMAGE1 FULL HD Camera Heads</th>
<th>IMAGE1 S H3-Z</th>
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</thead>
<tbody>
<tr>
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<td>Image sensor</td>
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<td>Weight</td>
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<td>Optical interface</td>
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<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
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<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
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<td>Cable</td>
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<td>Cable length</td>
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TH 104

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

Specifications:

<table>
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<tr>
<th>IMAGE1 FULL HD Camera Heads</th>
<th>IMAGE1 S H3-ZA</th>
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<tbody>
<tr>
<td>Product no.</td>
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<tr>
<td>Image sensor</td>
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<td>Weight</td>
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<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, f = 15–31 mm (2x)</td>
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<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
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<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
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</table>
Monitors

9619 NB

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

9826 NB

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

### KARL STORZ HD and FULL HD Monitors

<table>
<thead>
<tr>
<th>Model</th>
<th>Input/Output</th>
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<th>Input/Output</th>
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<tbody>
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<td>9619 NB</td>
<td>DVI-D</td>
<td>●</td>
<td>●</td>
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<td>9619 NB</td>
<td>Fibre Optic</td>
<td>–</td>
<td>–</td>
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<tr>
<td>9619 NB</td>
<td>3G-SDI</td>
<td>–</td>
<td>●</td>
</tr>
<tr>
<td>9619 NB</td>
<td>RGBS (VGA)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>9619 NB</td>
<td>S-Video</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>9619 NB</td>
<td>Composite/FBAS</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>9826 NB</td>
<td>DVI-D</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>9826 NB</td>
<td>S-Video</td>
<td>●</td>
<td>–</td>
</tr>
<tr>
<td>9826 NB</td>
<td>Composite/FBAS</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>9826 NB</td>
<td>RGBS (VGA)</td>
<td>●</td>
<td>–</td>
</tr>
<tr>
<td>9826 NB</td>
<td>3G-SDI</td>
<td>–</td>
<td>●</td>
</tr>
</tbody>
</table>

### Signal Format Display:

- 4:3
- 5:4
- 16:9
- Picture-in-Picture
- PAL/NTSC compatible

### Optional accessories:

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

### Specifications:

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

495 NL  Fiber Optic Light Cable, with straight connector, diameter 3.5 mm, length 180 cm
495 NA  Same, length 230 cm

Cold Light Fountain XENON 300 SCB

20133101-1  Cold Light Fountain XENON 300 SCB with built-in antifog air-pump, and integrated KARL STORZ Communication Bus System SCB power supply: 100–125 VAC/220–240 VAC, 50/60 Hz including:
Mains Cord
SCB Connecting Cable, length 100 cm
20133027  Spare Lamp Module XENON with heat sink, 300 watt, 15 volt
20133028  XENON Spare Lamp, only, 300 watt, 15 volt

Cold Light Fountain XENON NOVA® 300

20134001  Cold Light Fountain XENON NOVA® 300, power supply: 100–125 VCA/220–240 VAC, 50/60 Hz including:
400 A  Mains Cord
20132028  XENON Spare Lamp, only, 300 watt, 15 volt
Data Management and Documentation
KARL STORZ AIDA® – Exceptional documentation

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

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

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

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

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

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

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

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

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

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

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

**Reference**
All important patient information is always available and easy to access. Completed procedures including all information, still images, videos, and the checklist report can be easily retrieved from the Reference module.
Equipment Cart

**Monitor Swivel Arm,**
height and side adjustable,
can be turned to the left or the right side,
swivel range 180°, overhang 780 mm,
overhang from centre 1170 mm,
load capacity max. 15 kg,
with monitor fixation VESA 5/100,
for usage with equipment carts UG xxx

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

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

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

**UG 310**

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

**UG 410**

Earth Leakage Monitor,
200 V–240 V, for mounting at equipment cart, control panel dimensions: 44 x 80 x 29 mm (w x h x d), for usage with isolation transformer UG 310

**UG 510**

Monitor Holding Arm,
height adjustable, inclinable, mountable on left or right, turning radius approx. 320°, overhang 530 mm, load capacity max. 15 kg, monitor fixation VESA 75/100, for usage with equipment carts UG xxx
Notes:

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