ENDOSCOPE-ASSISTED RETROSIGMOID KEYHOLE APPROACH (RSA) FOR OTONEUROLOGICAL SURGERY

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EndoscopE-AssistEd REtRosigmoid KEYHoLE AppRoAcH (RsA) for otonEuRoLogicAl suRgERY

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1.0 Introduction

The minimal retrosigmoid approach (RSA) was first described by Bremond et al.\textsuperscript{1,2}. In the meantime, it has been more than 25 years since Jannetta established the microvascular decompression (MVD) for trigeminal neuralgia and hemifacial spasm utilizing the suboccipital approach in a sitting position\textsuperscript{3}. This method is already established as a fundamental treatment option\textsuperscript{4,5}.

In our modern society, there is a continuous demand for providing surgical care while meeting the highest possible safety standards and reducing invasiveness to a minimum. Nowadays, we are in the position to surgically treat a wide range of lesions of the cerebellopontine angle (CPA) by use of this outstanding minimal retrosigmoid approach. At the same time, it should not be ignored, that CPA lesion surgery is functional surgery, that must be performed with utmost care without any complications or secondary disease remaining.

We have performed this type of surgery since 1974 with good results, which is documented by an extensive record of publications\textsuperscript{6,7,8,9}. Since 1990, we started combining the use of endoscopes and have achieved a safer, more reliable RSA surgery. We examined these surgical methods conducted by a neuro-otologic team with this approach.

2.0 Surgical Anatomy for the Keyhole RSA

Optimizing the operative approaches to the cranial nerves in the posterior cranial fossa requires an understanding of the relationship of these nerves to the cerebellar arteries, brain stem, and cerebellar surfaces\textsuperscript{10}. When examining these, three neurovascular complexes can be defined: an upper complex related to the superior cerebellar artery (SCA); a middle complex related to the anterior inferior cerebellar artery (AICA); and a lower complex related to the posterior inferior cerebellar artery (PICA) and vertebral artery (VA) (Fig. 1).

Superior and posterior anatomical views of a right and left CPA.
The upper complex includes the trigeminal nerve, SCA, midbrain, cerebellomesencephalic fissure, superior cerebellar peduncle, tentorial surface of the cerebellum, and oculomotor, trochlear nerves. The trigeminal root joins the brain stem about halfway between the lower and upper borders of the pons. In its intradural course, the trigeminal nerve uniformly runs obliquely upwards from the lateral part of the pons towards the petrous apex. It exits the posterior fossa to enter the middle cranial fossa by passing forwards beneath the tentorial attachment to enter the Meckel's cave. The SCA arises in front of and encircles the midbrain, passes below the oculomotor and trochlear nerves and above the trigeminal nerve to reach the cerebellomesencephalic fissure, where it runs on the superior cerebellar peduncle and terminates by supplying the tentorial surface of the cerebellum.

The middle complex includes the acoustico-facial nerve bundle, the AICA, pons, middle cerebellar peduncle, cerebellopontine fissure, petrosal surface of the cerebellum, and abducens nerve. The acoustico-facial nerve bundle arises from the brain stem near the lateral end of the pontomedullary sulcus. The facial nerve arises in the pontomedullary sulcus 1–2 mm anterior to the point at which the vestibulocochlear nerve joins the brain stem at the lateral end of the sulcus. The upper cranial nerves. The interval between the vestibulocochlear and facial nerves is greatest at the level of pontomedullary sulcus and decreases as these nerves approach the meatus. In the CPA the facial and vestibulocochlear nerves run forward and lateral to the posterior surface of the petrous bone to enter the internal auditory canal (IAC). During their cisternal course the facial is anteriorly and the vestibular nerve is superiorly while cochlear nerve is inferiorly, the facial nerve is medial and vestibulocochlear are lateral. As they approach the foramen of the IAC the facial and vestibular are superior, the cochlear is inferior, the facial and cochlear are medial and vestibular nerve is lateral. The AICA arises at the pontine level, courses in relationship to the abducens, facial, and vestibulocochlear nerves to reach the surface of the middle cerebellar peduncle, where it courses along the cerebellopontine fissure and terminates by supplying the petrosal surface of the cerebellum.

The lower complex includes the lower cranial nerves (the glossopharyngeal, vagus, spinal accessory, and hypoglossal nerves), the PICA, medulla, inferior cerebellar peduncle, cerebellomedullary fissure, and suboccipital surface of the cerebellum. The glossopharyngeal nerve arises as one or rarely two rootlets from the upper medulla, posterior to upper one third of the olive, just caudal to the origin of the facial nerve. It courses ventral to the choroid plexus protruding from the foramen of Luschka on its way to the jugular foramen. The vagus nerve arises inferior to the glossopharyngeal nerve as a line of tightly packed rootlets along a line 2–5.5 mm in length posterior to the superior one third of the olive. The vagus is composed of multiple combinations of large and small rootlets that pass ventral to the choroid plexus protruding from the foramen of Luschka on its way to the anteromedial part of the pars venosa. The spinal accessory nerve arises as a widely separated series of rootlets that originate from the medulla at the level of the lower two thirds of olive and from the upper cervical cord. The cranial rootlets of the spinal accessory nerve arise as a line of rootlets just caudal to the vagal fibers. The spinal accessory fibers pass superolaterally from their origin to reach the jugular foramen. The PICA arises at the medullary level, encircles the medulla passing in relation to the glossopharyngeal, vagus, spinal accessory, and hypoglossal nerves to reach the surface of the inferior cerebellar peduncle, where it dips into the cerebellomedullary fissure and terminates by supplying the suboccipital surface of the cerebellum.
During endoscope-assisted RSA, (Figs. 2, 3) the acousticofacial nerve bundle serves as anatomical reference level. By crossing the middle of the CPA it defines two separate areas of surgical anatomy. Superiorly, the trigeminal area should be inspected for treatment of trigeminal neuralgia. Inferiorly, the area of the lower cranial nerves should be scrutinized for treatment of hemifacial spasm and glossopharyngeal neuralgia. In tumor surgery, e.g., surgery of acoustic neurinoma, menigioma and epidermoid cyst, it is important to visualize and conduct the surgery using an endoscope from both sides of the trigeminal area and the area of the lower cranial nerves.

### 3.0 Indications

We have been performing operations since 1990 by using the combined endoscopic and microsurgical technique. We have achieved a safer, more reliable exploration through keyhole RSA for CPA surgery with low invasiveness. By utilizing this approach, we have performed operations such as MVD for vascular compression syndromes, tumor removal of small and medium size acoustic neurinoma and menigioma, and vestibular neurotomy for refractory Meniere's disease with recurring paroxysms of vertigo. The vascular compression syndromes are associated with trigeminal neuralgia (in French: *tic douloureux*) and hemifacial spasm, but other disorders such as glossopharyngeal neuralgia, tinnitus and disabling positional vertigo can also be successfully treated by MVD of the cranial nerve involved.

With the advancements made in diagnostic imaging technology, not only early diagnosis of small schwannoma and menigioma became possible, but there has been an increase in chance with neurovascular conflicts to be confirmed as the cause of a cranial nerve dysfunction, if a neurovascular conflict in the CPA has been diagnosed as the major cause of cranial nerve dysfunction.
4.0 Surgical Procedure

4.1 Patient Positioning and Anesthesia

The patient is placed in supine position, the head flexed and turned to the contralateral side around 70–80°. To protect the face, fasten the forehead of the healthy side with a gel sheet, without three points bracing of the skull. The head is raised from horizontal up to 30° (Figs. 4, 5). Right side craniotomy requires special care for the head position, making sure that the ipsilateral shoulder does not restrict the surgeon’s right arm movement. For the area to be shaved, only 2 to 3 cm behind the ear is sufficient.

General endotracheal anesthesia is administered, profound and balanced, with analgesics, hypnotics, or neuroleptics (Propofol, Sufentanil). Before opening the dura mater, the patient is hyperventilated to obtain hypocapnia to lower intracranial pressure, which helps spontaneous cerebellar retraction. This step facilitates penetration in the CPA without the use of a cerebellar retractor. Nowadays, there is no longer need to use lumbar puncture and mannitol (20 %) infusion to induce such a spontaneous cerebellar retraction.

4.2 Craniotomy

The minimally invasive retrosigmoid craniotomy is performed using the following anatomical landmarks:

1. The posterior prolongation of the Frankfurt line running from the outer canthus to the superior edge of the external auditory canal is the first line of reference. A second oblique line follows the posterior margin of the mastoid process. A 2-cm-diameter keyhole is drawn below and behind the point where the two lines intersect (Fig. 6). This keyhole indicates the position of the craniotomy.
2. A curved 6-to-8-cm skin incision, with the convex side towards the back is made from the tip of the mastoid passing along the backside of the previously drawn keyhole (Fig. 6).
3. Once adequate exposure of the bone surface has been achieved by reflecting the scalp flap forward, the craniotomy is drilled using the mastoid emissary vein as central landmark (Figs. 7, 8). The bone dust is collected to prepare a bone paste which is solidified with fibrin glue, and shaped as plates that are used for wound closure and packing (Fig. 9). In order to prevent cerebrospinal fluid leakage, all opened mastoid air cells are obliterated with bone wax.
When the operation reaches the posterior fossa dura and posterior margin of the sigmoid sinus (Fig. 10), the operating microscope is used. After adequate hemostasis, an anterior-based U-shaped dura flap is made with the surgical knife (Fig. 11). The cerebrospinal fluid escapes and the surgeon waits for the spontaneous cerebellar retraction to occur, which is induced by controlled hypocapnia as a result of hyperventilation. A fine neurosurgical cotton, with 1.5 cm in width, and 5 cm in length, protects the cerebellum. The surgeon advances as far as the posterior fossa through a safe surgical corridor (Figs. 12, 13), the posterior wall of the temporal bone above, and the protected cerebellum below, until reaching and opening the posterior cisterna at the level of the area of the lower cranial nerves (Figs. 14, 15). Once adequate cerebellar relaxation has been achieved, no brain retractor is necessary.
4.3 Endoscopic Equipment

The HOPKINS® endoscopes used are mainly the ones mentioned below.

- 6 cm in length, 4.0 mm in diameter, 0° (KARL STORZ 1215 AA)
- 6 cm in length, 4.0 mm in diameter, 30° (KARL STORZ 1215 BA)
- 11 cm in length, 4.0 mm in diameter, 30° (KARL STORZ 1216 BA)
- 11 cm in length, 2.7 mm in diameter, 30° (KARL STORZ 1230 BA)

We use these endoscopes according to the individual situation, but the scope we use most is the 30° forward-oblique HOPKINS® telescope, diameter 4 mm, length 11 cm. With regard to the learning curve inherent to the endoscopic procedure, the surgeon-in-training is advised to use only the scopes with 6 cm in length, which is safer to prevent injury. The telescopes, along with the fiber optic light cables are fully autoclavable. By wrapping the camera cable and camera adaptor with a sterilized polyethylene cover, endoscopes can be exchanged easily within the sterile area. In order to maintain asepsis, the endoscopic examination is followed on a monitor rather than viewing directly.

4.4 CPA Endoscopy and its Benefits

The endoscope should be inserted cautiously by gradually advancing along the fine neurosurgical cotton. Care must be paid during insertion of the scope to prevent contact with adjacent nerves and vessels; therefore, it is highly recommended that the scope be held with both hands. More specifically, it is important to hold the scope with the non-dominant hand while guiding the camera with the other, just to make sure that safe and accurate visualization can be provided (Figs. 17–20).
On account of the endoscope’s panoramic view there is no blind spot and all the components crossing the CPA come under visual control without the need for excessive retraction of the cerebellum. The use of a 30°-forward-oblique telescope is generally recommended and often proves effective. Occasionally, adequate information may also be obtained by use of a 0°-scope. There are also two other endoscopes with directions of view 45° and 70°, respectively, but the tip of the telescope is difficult to control, involving the risk of iatrogenic damage to healthy neural tissue. In any case, care must be taken to keep the tip of the scope away from nerves and vessels to prevent inadvertent thermal injury.

The Benefits of the Endoscope

The acoustico-facial nerve bundle and its entrance into the IAC represent the reference level in the middle of the CPA (Fig. 21), the trigeminal area (A) and the area of the lower cranial nerves (B). Fig. 22 captures the view of A offered by a 30°-endoscope while area B is shown on Fig. 23 (taken with the same scope).
Endoscope-assisted surgery provides more critical information which cannot be obtained by the use of an operating microscope alone. Thus, the endoscope is a valuable and indispensable optical device that allows to perform less invasive surgery with improved accuracy and patient safety. The adjunct use of the endoscope in microsurgery of the CPA is particularly helpful in MVD and tumor removal. The major merit of the endoscope is to eliminate blind spots and the provision of reliable information in a short time, reducing the length of the surgical procedure.

Figs. 24, 25 show a tumoral process on the eighth cranial nerve obviously arising from its vestibular component. Fig. 26 shows the view through a 30°-endoscope after drilling of the posterior wall of the internal auditory canal and removal of the acoustic neurinoma. This is useful to confirm mastoid air cells and the absence of residual tumor.
5.0 Endoscope-Assisted Microsurgery

5.1 Acoustic Neuroma Surgery (Figs. 27–36)

The primary goal of surgery is to remove the tumor as completely as possible, while trying to preserve hearing and facial nerve function as best as we can. Along with the use of a HOPKINS® 30°-forward-oblique endoscope that allows to localize the tumor and the nerves, endoscopic visualization of the fundus of the IAC is very helpful in this stage of the operation, because this anatomical site is difficult to inspect with a microscope alone. Fully endoscopic surgery can be performed successfully to remove the lateral part of the tumor at the fundus without causing any neurosensorial damage.

Right Intracanalicular Acoustic Neurinoma
(Endoscopy and Imaging Techniques)

1: trigeminal nerve; 2: facial nerve; 3: cochlear nerve; 4: lower cranial nerves
AN: acoustic neurinoma. Fig. 29, taken through a 30° endoscope, shows part of the residual tumor expanding along the facial nerve within the IAC.
Figs. 31 to 36 are endoscopic views of a medium-sized left acoustic neurinoma. Fig. 30 is a detail of a MRI axial section correlated with Fig. 31. In the authors’ experience, the 30°-endoscope has proven to be a very useful optical device for assessment of, first, the facial nerve at its medial course, which is obscured by the tumor (Figs. 33, 34), second, the internal auditory canal and the lateral extension of the neurinoma (Figs. 35) with a residual tumor (Fig. 36) that cannot be visualized with the operating microscope.
5.1.1 Step-by-Step Sequence of Endoscope-Assisted Retrosigmoid Keyhole Approach for Removal of Acoustic Neuroma (Figs. 37–48)
5.1.2 Fully Endoscopic Procedure Inside the Internal Auditory Canal (Figs. 49–58)

Endoscopic surgery of the lateral part of the neurinoma occupying the internal auditory canal.
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery
5.2 Removal of Other Tumors

Meningioma and epidermoid cyst (Figs. 59, 60) have numerous adhesive lesions, often making it difficult to determine the course of the cranial nerves. During surgery of such tumors, therefore, multidirectional endoscopic visualization is of vital importance for accurate identification of the cranial nerves. Endoscopy is therefore more important for these tumors removal than acoustic neurinoma surgery, and because the surgical procedure is also conducted sometimes under endoscopy, its usefulness is very high. Moreover, because of the hypervascularity of meningioma, bleeding control is the key in the endoscopic procedure. A thorough and adequate hemostatic procedure is important also for other tumors.

Epidermoid Cyst

The patient had a large epidermoid cyst on the left side, and surgery was therefore conducted via the translabyrinthine approach. From IAC to CPA dense adhesions to the surrounding tissues were found, and obscured the course of the cranial nerves. The use of an endoscope and multidirectional visualization are essential for complete removal of the matrix of the epidermoid cyst.
5.3 Case Histories

- Microvascular Decompression for Hemifacial Spasm (Figs. 61–70)
- Trigeminal Neuralgia (Figs. 71–80)
- Glossopharyngeal Neuralgia (Figs. 81–84)
- Tinnitus (Figs. 85–89)

Hemifacial Spasm, First Case

Pre- and post-operative en-face images of a patient suffering from a right hemifacial spasm.

MRI axial section of the CPA. The loop of the PICA on the right side (white pointers) is in contact with the root exit zone (REZ) of the facial nerve and distorts the brain stem.

Facial nerve (VII). The loop of the PICA is in contact with the REZ of the facial nerve.

Microvascular decompression (MVD) via the retrosigmoid keyhole approach. A piece of Teflon sponge has been placed to separate the PICA loop from the REZ of the facial nerve.
Hemifacial Spasm, Second Case

Trigeminal nerve (V). Vestibulocochlear nerves (VIII). Right vertebral artery (Rt.VA and long black pointer in Fig. 66). Left vertebral artery (Lt.VA and black pointer in Fig. 66). Dandy vein (DV). The MRI axial section shows that both the right and left vertebral arteries are in contact with, and cause distortion of the root of the facial nerve (white pointer). The right vertebral artery is in contact with the REZ of the facial nerve, also the AICA passes between the facial and the vestibulocochlear nerve, then in contact again with the medial side of the facial nerve. The PICA is in contact with the trigeminal nerve. Fig. 68 is an endoscopic view from below the facial nerve. Both Rt.VA and Lt.VA are in contact with the root of the facial nerve. Figs. 69 and 70 were taken during endoscope-assisted MVD of both facial and trigeminal nerves freeing them from their offending vessels PICA and VA by interposition of a teflon pad.
Trigeminal Neuralgia, First Case

Meckel's cave (MC), Motor part of the trigeminal nerve (MP). MRI axial section at the level of the trigeminal nerve (black pointer) showing a loop of the superior cerebellar artery (SCA, white pointer) compressing the trigeminal nerve. Fig. 72 shows the SCA crossing the trigeminal nerve from above, then medially, then anteriorly. Note the tortuous course of the nerve which is stretched and lateralized by the loop of the SCA. Furthermore, the motor part of the trigeminal nerve is pushed upward by the vascular loop, above the trigeminal nerve. The loop of the SCA is surgically mobilized in superior and lateral aspects of the nerve, which is decompressed by this maneuver. The normal course of the SCA has been restored and tension relieved, as shown in Fig. 73.
Trigeminal Neuralgia, Second Case

The contrast-enhanced MRI axial section (Fig. 74) shows that the SCA (white pointer) is in contact with the right trigeminal nerve (black pointer). Endoscopic visualization (Figs. 75, 76) confirms that a loop of the SCA (black pointers) is in contact with the trigeminal nerve. The loop of the SCA is transposed and isolated from the trigeminal nerve. A piece of connective tissue (CT) is inserted to prevent recurrence of adhesions and formation of a secondary neurovascular conflict.
Trigeminal Neuralgia, Third Case

Neurovascular conflicts due to compression by venous vessels account for 20% of cases of trigeminal neuralgia. Microvascular decompression involves that the offending venous structures are coagulated or, in rare cases, isolated from the nerve (Figs. 79, 80).
Glossopharyngeal Neuralgia

Glossopharyngeal nerve (IX). MRI axial section at the level of the lower cranial nerves presenting a loop of PICA (Fig. 81, black pointers) in contact with the glossopharyngeal nerve. Fig. 82 is a microscopic image of a PICA loop in contact with the glossopharyngeal nerve at its base, and also in contact with the REZ of the facial nerve (VII). The endoscopic image shows the PICA loop after it has been elevated above the glossopharyngeal nerve. Figs. 83, 84 were taken after separation of the PICA loop from both the facial and glossopharyngeal nerves by use of Teflon sponges. Use of the panoramic view allows endoscopic visualization while avoiding any inadvertent traumatic retraction of neural structures. Vestibulocochlear nerve (VIII).
Tinnitus

The case of a patient with left-sided tinnitus. Microscopic examination (Fig. 85) revealed that a complex of AICA loops got wedged along the course of the cochlear nerve. The vessel was transposed from the cochlear nerve. In the REZ, the cochlear nerve was decompressed with a teflon sponge placed between the AICA loops.

(Figs. 88, 89) The subarcuate artery can be the cause of auditory nerve compression. The artery is coagulated. If a vascular loop syndrome has been identified as the underlying cause of tinnitus, this can be treated with the highest rate of success by microvascular decompression.
5.3.1 Step-by-Step Endoscope-Assisted Microvascular Decompression (Left Hemifacial Spasm)

At the beginning of the procedure, the endoscope’s panoramic view is used to identify the neurovascular conflict and the course of the offending vessels (Figs. 90–106). We perform the decompression by first inserting a Teflon sponge between the offending vessel and the nerve involved. Secondly, the offending vessel is mobilized and attached to the dura mater of the petrous bone by use of fibrin glue (Figs. 116–126). The endoscope is again used to assess and confirm the proper positioning of the Teflon sponge, once it has been placed at the target site (Figs. 127–131).
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

**Figs. 92–94**
Endoscopic view of the acousticofacial nerve bundle.

**Figs. 95–98**
The tip of the scope is above the acousticofacial bundle and faces the trigeminal nerve.
The tip of the scope is located below the acousticofacial nerve bundle which allows the course of the offending vessel (anterior inferior cerebellar artery, AICA) to the facial nerve to be clearly recognized.

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**Figs. 99–100**

The tip of the scope is located below the acousticofacial nerve bundle which allows the course of the offending vessel (anterior inferior cerebellar artery, AICA) to the facial nerve to be clearly recognized.
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

Figs. 92–106
Endoscopy of the cerebellopontine angle with the tip of the forward-oblique endoscope facing the brain stem.
Figs. 107–115
Using the same endoscope as in the previous sequence the distal tip faces the petrous bone.
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

Figs. 116–126
Microvascular decompression.
Facial nerve (*), auditory nerve (AN), Teflon sponge (T).
Figs. 127–131
Endoscopic examination for proper placement of the Teflon sponge. Facial nerve (white / black *).
5.4 Vestibular Neurotomy

At first, we determine the exact three-dimensional position of the acousticofacial nerve bundle. Next, a cleavage plane is created and separating the vestibular portion from the cochlear portion carefully at the porus acusticus with a small dissector. Then we usually expose the small segment of the vestibular portion at the site of the porus. This maneuver is intended to prevent misconnection in later stages of the operation. The endoscope is very useful to localize the position of the facial nerve passing below the cochlear nerve and entering the fundus at the rostral corner of the internal auditory canal (IAC).
Figs. 132–139
Vestibular nerve (1), cochlear nerve (2), trigeminal nerve (3), cochlear artery (4). The right vestibular nerve is transected. Figs. 132, 136 and 137 are intraoperative views captured through the surgical microscope. In Fig. 139, the facial nerve and the course of the artery, that runs between the facial and cochlear nerves, are clearly visible right behind the vestibular nerve cut section.
6.0 Wound Closure

The dura mater is sutured meticulously using 5/0 silk sutures. Gaps between sutures are covered with pieces of muscle and then finished with a layer of fibrin glue in order to create a perfectly sealed suture. Before closing the dura completely, the CPA is filled with physiologic saline at body temperature to exclude air bubble formation, which can induce postoperative pneumocephalus as well as headache.

The dura is covered by a piece of Surgicel® and a layer of fibrin glue (Figs. 140, 141). The craniotomy is then filled with a mixture of bone paste and fibrin glue (Fig. 142). An additional layer of adipose tissue may also be used.

The musculoaponeurotic flap is sutured in place (Fig. 143). Finally, the subcutaneous layer is sutured followed by skin closure (Fig. 144).
The surgical wound is very small, and truly fulfills the criteria of a minimally invasive approach.

7.0 Results and Complications

From 1994 to 2008 a total number of 1,698 patients were operated on at our institution, including 511 acoustic neurinomas, 453 hemifacial spasms, 269 trigeminal neuralgias, 4 glossopharyngeal neuralgias, 56 cases of tinnitus, and 405 vestibular neurotomies for incapacitating Menière disease. In all surgeries, access to the operative field was established by an endoscope-assisted retrosigmoid keyhole approach. The method has proved to be efficient and suitable, and allowed us to perform the operations safely and reproducibly via a small craniotomy. The favorable results of the series of operations are a testimony to this statement, and equally holds true if the procedure is applied properly in elderly patients. We had more than 150 patients aged 70 years or older, the oldest patient was 84 years of age. The mean hospital stay was 8 days. Extensive data on the surgical results in the treatment of each of these diseases can be found in numerous bibliographical resources6–9, 11, 12.

We have not experienced any major complications during our 20 years practice. In all cases of our keyhole RSA series, the major postoperative morbidity was CSF leakage, and overall postoperative morbidity related to microvascular decompression surgery was less than 3%. According to the follow-up protocol applied in our institution, revision surgery is required if remission of CSF leakage by conservative treatment cannot be achieved within a time frame of three days. In all cases of our series, we had no serious complication and no mortality records.
8.0 Comments

We have performed otologic or neuro-otologic surgery with the adjunctive use of endoscopes since 1989\textsuperscript{13,14} and the minimally invasive access to the CPA via a retrosigmoid approach since 1974\textsuperscript{1-2}. The main emphasis of this booklet is on endoscope-assisted MVD, vestibular neurotomy and tumor removal performed via a retrosigmoid keyhole approach. Since these surgical procedures have been designed for the treatment of functional disorders, it is needless to say that any complications are not acceptable. Minimally invasive surgery must be developed further while decreasing the inherent surgical risks and reducing the surgical costs\textsuperscript{15}. In order to perform the most accurate and safe surgery as possible, the endoscope has proven to be an indispensable adjunct. Furthermore, a critical premise is that the surgeon must have good knowledge of the anatomy of the skull base, as well as adequate training in both endoscopic and microsurgical procedures.

As one of the best training methods, we strongly recommend to make drawings of the stereoscopic positions of nerves, blood vessels, tumor etc., derived in advance from the preoperative CT, MRI and angiography findings, and intended to serve as preparatory exercise prior to surgery. Moreover, even if one is not an operating surgeon, the habit of briefly sketching the anatomical landmarks and surgical findings is important. For many neuro-otologic surgeons, acquisition of thorough understanding and intuitive judgement of the very complex anatomy of the posterior cranial fossa and lateral skull base, requires a lot of experience and time. We are convinced that, thorough anatomical knowledge founded on cadaver dissection studies along with repetitive clinical training are the shortcuts to mastering keyhole RSA within a short time (Figs. 145, 146).
9.0 Surgical Steps and Illustrations

Left acoustic neurinoma.

Right vestibular neurotomy.

Right vestibular neurotomy.

Legend of Acronyms:

AN Abducent nerve
AICA Anterior inferior cerebellar artery
CN Cochlear nerve
DV Dandy vein
FN Facial nerve

N Neurinoma
TrN Trigeminal nerve
TroN Trochlear nerve
VN Vestibulocochlear nerve
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

Legend of Acronyms:
- ATV Aberrant trigeminal vein
- SCA Superior cerebellar artery
- SPV Superior petrosal vein
- Tp Teflon pads
- TrN Trigeminal nerve
- TroN Trochlear nerve
- * Coagulated parts
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

Left trigeminal neuralgia. The entrance of Meckel's cave is visible.

Left trigeminal neuralgia.

Legend of Acronyms:

- ATP: Aberrant trigeminal vein
- SCA: Superior cerebellar artery
- TriN: Trigeminal nerve
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

Legend of Acronyms:
- AIC A: Anterior inferior cerebellar artery
- CN: Cochlear nerve
- CP: Choroid plexus
- FN: Facial nerve
- GN: Glossopharyngeal nerve
- PICA: Posterior inferior cerebellar artery
- VA: Vertebral artery
- VN: Vagus nerve
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

Figs. 155–159
Right hemifacial spasm with PICA as offending vessel at the root exit zone of the facial nerve, which is the most common case.

Legend of Acronyms:
FN Facial nerve
LCN Lower cranial nerves
PICA Posterior inferior cerebellar artery
Tp Teflon pad
References


Recommended Sets for the Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA)
HOPKINS® Telescopes
for Tympanoscopy, Examination of the Middle Ear and Rhinoscopy
Diameter 4 mm, length 6 cm

1215 AA
Tele-Otoscope with HOPKINS® Straight Forward Telescope 0°,
diameter 4 mm, length 6 cm, autoclavable,
fiber optic light transmission incorporated,
color code: green

1215 BA
Tele-Otoscope with HOPKINS® Forward-Oblique Telescope 30°,
diameter 4 mm, length 6 cm, autoclavable,
fiber optic light transmission incorporated,
color code: red

Diameter 4 mm, length 11 cm

1216 AA
HOPKINS® Straight Forward Telescope 0°,
for oto-nasopharyngoscopy, diameter 4 mm, length 11 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: green

It is recommended to check the suitability of the product for the intended procedure prior to use.
HOPKINS® Telescopes
for Tympanoscopy, Examination of the Middle Ear and Rhinoscopy
Diameter 2.7 mm, length 11 cm

HOPKINS® Straight Forward Telescope 0°,
diameter 2.7 mm, length 11 cm, autoclavable,
fiber optic light transmission incorporated,
color code: green

HOPKINS® Forward-Oblique Telescope 30°,
diameter 2.7 mm, length 11 cm, autoclavable,
fiber optic light transmission incorporated,
color code: red

HOPKINS® Lateral Telescope 70°,
diameter 2.7 mm, length 11 cm, autoclavable,
fiber optic light transmission incorporated,
color code: yellow

HOPKINS® Telescopes
for Endoscope-Assisted Micro Neurosurgery (EAM)
Diameter 4 mm, length 18 cm

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

HOPKINS® Forward-Oblique Telescope 30°,
enlarged view, diameter 4 mm, length 18 cm, autoclavable,
fiber optic light transmission incorporated,
color code: red
Microinstruments for Dissection of the Internal Auditory Canal

223980 MAGNAN Dissector Pick, bayonet-shaped, 90° single-curved downwards, width 1.2 mm, length 20 cm

*Particularly suitable for dissection of the lateral extent of the temporal process at the level of the fundus of the IAC*

223990 Same, 90° single-curved upwards

*Particularly suitable for dissection of the lateral extent of the temporal process at the level of the fundus of the IAC*

223982 MAGNAN Raspatory, bayonet-shaped, double-curved downwards, width 2.0 mm, length 20 cm

*Particularly suitable for intracanalicular dissection of the temporal process along the course of the cochlear, vestibular and facial nerves.*

223992 Same, double-curved upwards

*Particularly suitable for intracanalicular dissection of the temporal process along the course of the cochlear, vestibular and facial nerves.*

223984 MAGNAN Raspatory, bayonet-shaped, tip round-curved downwards, width 2.0 mm, length 20 cm

*Particularly suitable for fully endoscopic procedures at the level of the fundus of the IAC. Useful for removal of residual tumor (the blade of the raspatory follows and protects the facial nerve). The residual tumor is elevated superiorly and posteriorly*

223994 Same, tip round-curved upwards

*Particularly suitable for fully endoscopic procedures at the level of the fundus of the IAC. Useful for removal of residual tumor (the blade of the raspatory follows and protects the facial nerve). The residual tumor is elevated superiorly and posteriorly*
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

**Round Knives, Picks and Metal Tray**

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<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>223901</td>
<td><strong>Round Knife 0°</strong>, bayonet-shaped, straight, diameter 1.5 mm, length 18.5 cm</td>
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<tr>
<td>223905</td>
<td><strong>Round Knife 45°</strong>, bayonet-shaped, curved upwards, diameter 1.5 mm, length 18.5 cm</td>
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<tr>
<td>223906</td>
<td><strong>Same</strong>, curved downwards</td>
</tr>
<tr>
<td>223908</td>
<td><strong>Round Knife 45°</strong>, bayonet-shaped, curved downwards, diameter 2.3 mm, length 18.5 cm</td>
</tr>
<tr>
<td>223910</td>
<td><strong>Round Knife 90°</strong>, bayonet-shaped, curved upwards, diameter 1.5 mm, length 18.5 cm</td>
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<td>223911</td>
<td><strong>Same</strong>, curved downwards</td>
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<tr>
<td>223942</td>
<td><strong>Pick, 90°</strong>, bayonet-shaped, curved upwards, 1 mm, length 18.5 cm</td>
</tr>
<tr>
<td>223943</td>
<td><strong>Same</strong>, curved downwards</td>
</tr>
<tr>
<td>223946</td>
<td><strong>Pick, 90°</strong>, bayonet-shaped, curved upwards, 2 mm, length 18.5 cm</td>
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<td>223947</td>
<td><strong>Same</strong>, curved downwards</td>
</tr>
<tr>
<td>223956</td>
<td><strong>Pick, 45°</strong>, bayonet-shaped, curved upwards, 2 mm, length 18.5 cm</td>
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<td>223957</td>
<td><strong>Same</strong>, curved downwards</td>
</tr>
<tr>
<td>223999</td>
<td><strong>Metal Tray</strong>, for sterilizing and storage of ear instruments, perforated, bottom part with holder for 16 bayonet-shaped ear micro-instruments, lid with silicone bridges, external dimensions (w x h x d): 250 x 240 x 40 mm</td>
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**Instruments**

for Endoscope-Assisted Micro Neurosurgery (EAM)

**MORTINI Recommended Set**

28164 MDA  **MORTINI Dissector**, “dead hand”, bayonet-shaped, 1.5 mm, curved upwards, with round handle, working length 16 cm

28164 MDD  Same, curved downwards

28164 MDB  **MORTINI Dissector**, “dead hand”, bayonet-shaped, 3 mm, curved upwards, with round handle, working length 16 cm

28164 MDE  Same, curved downwards

**Instruments**

for Endoscope-Assisted Micro Neurosurgery (EAM)

**GALZIO Recommended Set**

28164 HGB  **Micro Hook**, bayonet-shaped, curved upwards, blunt, working length 13.5 cm

28164 POA  **Dissector**, bayonet-shaped, curved upwards, working length 13.5 cm

28164 PUA  **Dissector**, bayonet-shaped, curved downwards, working length 13.5 cm
Microscopic/Endoscopic Skull Base and Pituitary Surgery

28164 EL  Micro Raspatory, single curved to left, width 2 mm, length 27 cm
28164 ER  Same, single curved to right
28164 KA  Curette, round spoon, tip slightly angled, size 1 mm, with round handle, length 23 cm
28164 KB  CAPPABIANCA-de DIVITIIS Curette, round spoon, tip slightly angled, size 2 mm, with round handle, length 23 cm
28164 KC  Curette, round spoon, tip slightly angled, size 3 mm, with round handle, length 23 cm

663533  Dissector, S-shaped curved tip, curved to left, width 1 mm, 3 mm long, right, length 20 cm
663534  Same, curved to right
663535  Dissector, hook-shaped, curved to right, diameter 0.5 mm, length 17.5 cm
UNIDRIVE® S III ENT SCB/UNIDRIVE® S III ECO

The multifunctional unit for ENT

UNIDRIVE® S III ENT SCB

UNIDRIVE® S III ECO

Special Features:

- Touch Screen: Straightforward function selection via touch screen
- Set values of the last session are stored
- Optimized user control due to touch screen
- Choice of user languages
- Operating elements are single and clear to read due to color display
- One unit – multifunctional:
  - Shaver system for surgery of the paranasal sinuses and anterior skull base
  - INTRA Drill Handpieces (40,000 rpm and 80,000 rpm)
  - Sinus Shaver
  - Micro Saw
  - Dermatome
  - High-Speed Handpieces (60,000 rpm and 100,000 rpm)
- Two motor outputs: Two motor outputs enable simultaneous connection of two motors:
  - For example, a shaver and micro motor
- Soft start function
- Textual error messages
- Integrated irrigation and coolant pump:
  - Absolutely homogeneous, micro-processor controlled irrigation rate throughout the entire irrigation range
  - Quick and easy connection of the tubing set
- Easy program selection via automated motor recognition
- Continuously adjustable revolution range
- Maximum number of revolutions and motor torque: Microprocessor-controlled motor rotation speed. Therefore the preselected parameters are maintained throughout the drilling procedure
- Maximum number of revolutions can be preset
- SCB model with connections to the KARL STORZ Communication Bus (KARL STORZ-SCB)
- Irrigator rod included

<table>
<thead>
<tr>
<th>Feature</th>
<th>UNIDRIVE® S III ENT SCB</th>
<th>UNIDRIVE® S III ECO</th>
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<tr>
<td>Touch Screen</td>
<td>●</td>
<td>-</td>
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<tr>
<td>Set values</td>
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<td>●</td>
</tr>
<tr>
<td>Optimized user control</td>
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<td>-</td>
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<td>Choice of user languages</td>
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<tr>
<td>Operating elements</td>
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<tr>
<td>One unit – multifunctional</td>
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<td>Shaver system</td>
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<td>Sinus Shaver</td>
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<tr>
<td>Micro Saw</td>
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<td>Dermatome</td>
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<td>High-Speed Handpieces</td>
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<td>Two motor outputs</td>
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<tr>
<td>Soft start function</td>
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<td>Textual error messages</td>
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<td>Integrated irrigation and coolant pump</td>
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<tr>
<td>Absolutely homogeneous, micro-processor</td>
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<td>controlled irrigation rate throughout the</td>
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<td>entire irrigation range</td>
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<td>Quick and easy connection of the tubing set</td>
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<tr>
<td>Easy program selection</td>
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<tr>
<td>Continuously adjustable revolution range</td>
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<td>Maximum number of revolutions and motor</td>
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<td>torque: Microprocessor-controlled motor</td>
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<td>SCB model with connections to the KARL</td>
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<td>STORZ Communication Bus (KARL STORZ-SCB)</td>
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<td>Irrigator rod included</td>
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Motor Systems
Specifications

System specifications

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<th>Order No.</th>
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<td></td>
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<tr>
<td>Operation mode:</td>
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<tr>
<td>Max. rev. (rpm):</td>
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<tr>
<td>oscillating</td>
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<tr>
<td>in conjunction with Handpiece:</td>
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<tr>
<td>DRILLCUT-X® II Shaver Handpiece</td>
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<tr>
<td>DRILLCUT-X® II N Shaver Handpiece</td>
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<tr>
<td>40 7120 50</td>
<td>10,000*</td>
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<tr>
<td>40 7120 55</td>
<td>10,000*</td>
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<td><strong>Sinus burr mode</strong></td>
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<tr>
<td>Operation mode:</td>
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<tr>
<td>Max. rev. (rpm):</td>
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<tr>
<td>rotating</td>
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<tr>
<td>in conjunction with Handpiece:</td>
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<tr>
<td>DRILLCUT-X® II Shaver Handpiece</td>
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<td>40 7120 50</td>
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<td><strong>High-speed drilling mode</strong></td>
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<tr>
<td>High-Speed Micro Motor</td>
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<tr>
<td>20 7120 33</td>
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<tr>
<td><strong>Drilling mode</strong></td>
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<td>Max. rev. (rpm):</td>
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<tr>
<td>counterclockwise or clockwise</td>
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<tr>
<td>micro motor and connecting cable</td>
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<tr>
<td>20 7110 33</td>
<td>40,000/80,000</td>
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<td>20 7111 73</td>
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<tr>
<td>micro motor and connecting cable</td>
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<tr>
<td>20 7110 33</td>
<td>15,000/20,000</td>
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<tr>
<td>20 7111 73</td>
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<tr>
<td>micro motor and connecting cable</td>
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<tr>
<td>20 7110 33</td>
<td>8,000</td>
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<tr>
<td>20 7111 73</td>
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</tr>
<tr>
<td><strong>Power supply:</strong></td>
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<tr>
<td>100 – 240 VAC, 50/60 Hz</td>
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<td><strong>Dimensions:</strong></td>
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<td>(w x h x d)</td>
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<tr>
<td>300 x 165 x 265 mm</td>
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<tr>
<td><strong>Two outputs for parallel connection of two motors</strong></td>
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<tr>
<td><strong>Integrated irrigation pump:</strong></td>
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<tr>
<td>Flow:</td>
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<tr>
<td>adjustable in 9 steps</td>
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* Approx. 4,000 rpm is recommended as this is the most efficient suction/performance ratio.

<table>
<thead>
<tr>
<th>UNIDRIVE® S III ENT SCB</th>
<th>UNIDRIVE® S III ECO</th>
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<tbody>
<tr>
<td><strong>Touch Screen:</strong></td>
<td>6,4&quot; / 300 cd/m²</td>
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<tr>
<td><strong>Weight:</strong></td>
<td>5.2 kg</td>
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<td><strong>Certified to:</strong></td>
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<tr>
<td><strong>Available languages:</strong></td>
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<td>IEC 60601-1</td>
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<tr>
<td><strong>Available languages:</strong></td>
<td>numerical codes</td>
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Motor Systems
Special features of high-performance EC micro motor II
and of the high-speed micro motor

Special features of high-performance EC micro motor II:
- Self-cooling, brushless high-performance EC micro motor
- Smallest possible dimensions
- Autoclavable
- Reprocessable in a cleaning machine
- Detachable connecting cable
- INTRA coupling enables a wide variety of applications
- Maximum torque 4 Ncm
- Number of revolutions can be continuously adjusted up to 40,000 rpm
- Provided a suitable handle is used, the number of revolutions can be continuously adjusted up to 80,000 rpm

20711033

2071033 High-Performance EC Micro Motor II, for use with UNIDRIVE® II/UNIDRIVE® ENT/OMFS/NEURO/ECO and Connecting Cable 20711073, or for use with UNIDRIVE® S III ENT/ECO/NEURO and Connecting Cable 20711173

20711173 Connecting Cable, to connect High-Performance EC Micro Motor 20711033 to UNIDRIVE® S III ENT/ECO/NEURO

Special Features of the high-speed micro motor:
- Brushless high-speed micro motor
- Smallest possible dimensions
- Autoclavable
- Reprocessable in a cleaning machine
- Maximum torque 6 Ncm
- Maximum torque 6 Ncm
- Number of revolutions can be continuously adjusted up to 60,000 rpm
- Provided a suitable handle is used, the number of revolutions can be continuously adjusted up to 100,000 rpm

20712033

20712033 High-Speed Micro-Motor, max. speed 60,000 rpm, including connecting cable, for use with UNIDRIVE® S III ENT/NEURO
UNIDRIVE® S III ENT SCB
UNIDRIVE® S III ECO
Recommended System Configuration

**UNIDRIVE® S III ENT SCB**

![UNIDRIVE® S III ENT SCB Image]

40701620-1

UNIDRIVE® S III ENT SCB, motor control unit with color display, touch screen, two motor outputs, integrated irrigation pump and 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 silicone tubing set
- SCB Connecting Cable, length 100 cm
- Single Use Tubing Set*, sterile, package of 3

**UNIDRIVE® S III ECO**

![UNIDRIVE® S III ECO Image]

40701420

40701401

UNIDRIVE® S III ECO, motor control unit with two motor outputs and integrated irrigation pump, power supply 100–240 VAC, 50/60 Hz including:

- Mains Cord
- Two-Pedal Footswitch, two-stage, with proportional function
- Clip Set, for use with silicone tubing set
- Single Use Tubing Set*, sterile, package of 3

**Specifications:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>UNIDRIVE® S III ENT SCB: 6.4*/300 cd/m²</th>
<th>Dimensions w x h x d</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch Screen</td>
<td>300 x 165 x 265 mm</td>
<td>5.2 kg</td>
<td></td>
</tr>
<tr>
<td>Flow</td>
<td>9 steps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>100–240 VAC, 50/60 Hz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Single Use Tubing Set is sterile and comes in a package of 3.*
UNIDRIVE® S III ENT SCB
UNIDRIVE® S III ECO
System Components
## Optional Accessories

for UNIDRIVE® S III ENT SCB and UNIDRIVE® S III ECO

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>280053</td>
<td><strong>Universal Spray</strong>, 6x 500 ml bottles – HAZARDOUS GOODS – UN 1950 including:</td>
</tr>
<tr>
<td></td>
<td><em>Spray Nozzle</em></td>
</tr>
<tr>
<td>280053 C</td>
<td><strong>Spray Nozzle</strong>, for the reprocessing of INTRA burr handpieces, for use with Universal Spray 280053 B</td>
</tr>
<tr>
<td>031131-10*</td>
<td><strong>Tubing Set</strong>, for irrigation, for single use, sterile, package of 10</td>
</tr>
</tbody>
</table>
INTRA Drill Handpieces
for Ear Micro Surgery

Special Features:
- Tool-free closing and opening of the drill
- Right/left rotation
- Max. rotating speed up to 40,000 rpm/80,000 U/min
- Detachable irrigation channels
- Lightweight construction
- Operates with little vibrations
- Low maintenance
- Reprocessable in a cleaning machine
- Safe grip

252570

INTRA Drill Handpiece, angled, length 12.5 cm, transmission 1:1 (40,000 rpm), for use with KARL STORZ high-performance EC micro motor II and straight shaft burrs

252573

INTRA Drill Handpiece, angled, length 12.5 cm, transmission 1:2 (80,000 rpm), for use with KARL STORZ high-performance EC micro motor II and straight shaft burrs

252590

INTRA Drill Handpiece, straight, length 11 cm, transmission 1:1 (40,000 rpm), for use with KARL STORZ high-performance EC micro motor II and straight shaft burrs
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

### Burrs

**Straight Shaft Burrs, length 7 cm, for use with INTRA Drill Handpieces 252590, 252570, 252573**

<table>
<thead>
<tr>
<th>Detail</th>
<th>Size</th>
<th>Dia. (mm)</th>
<th>Standard</th>
<th>Tungsten Carbide</th>
<th>Transverse Tungsten Carbide</th>
<th>Diamond</th>
<th>Diamond, coarse</th>
</tr>
</thead>
<tbody>
<tr>
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<td>260070</td>
<td>261070</td>
<td>—</td>
<td>262070</td>
<td>262270</td>
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</tbody>
</table>

260000  **Standard Straight Shaft Burr**, stainless, sizes 006–070, length 7 cm, set of 15

261000  **Tungsten Carbide Straight Shaft Burr**, stainless, sizes 006–070, length 7 cm, set of 15

261100  **Tungsten Carbide Straight Shaft Burr**, with cross cut, stainless, sizes 014–060, length 7 cm, set of 6

262000  **Diamond Straight Shaft Burr**, stainless, sizes 006–070, length 7 cm, set of 15

262200  **Rapid Diamond Straight Shaft Burr**, stainless, with coarse diamond coating for precise drilling and abrasion without hand pressure and generating minimal heat, sizes 023–070, length 7 cm, set of 9, color code: gold
Burrs

Straight Shaft Burrs, length 5.7 cm, for use with INTRA Drill Handpieces 252590, 252570, 252573

<table>
<thead>
<tr>
<th>Detail</th>
<th>Size</th>
<th>Dia. mm</th>
<th>Standard</th>
<th>Tungsten Carbide</th>
<th>Transverse Tungsten Carbide</th>
<th>Diamond</th>
<th>Diamond, coarse</th>
</tr>
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<tbody>
<tr>
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<td>649614 HK</td>
<td>649614 Q</td>
<td>649714 K</td>
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<td>018</td>
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<td>649618 HK</td>
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<td>649718 K</td>
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<td></td>
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<td>649623 K</td>
<td>649623 HK</td>
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<td>649723 GK</td>
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<td>649627 K</td>
<td>649627 HK</td>
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<td>649727 K</td>
<td>649727 GK</td>
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<td>649631 HK</td>
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<td>649731 GK</td>
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<td>649735 K</td>
<td>649735 GK</td>
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<td>040</td>
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<td>649750 GK</td>
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<td>649670 K</td>
<td>649670 HK</td>
<td>–</td>
<td>649770 K</td>
<td>649770 GK</td>
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</tbody>
</table>

649600 K  Standard Straight Shaft Burr, stainless, sizes 014–070, length 5.7 cm, set of 11
649600 HK Tungsten Carbide Straight Shaft Burr, stainless, sizes 014–070, length 5.7 cm, set of 11
649700 K  Diamond Straight Shaft Burr, stainless, sizes 014–070, length 5.7 cm, set of 11
649700 GK Rapid Diamond Straight Shaft Burr, stainless, with coarse diamond coating for precise drilling and abrasion without hand pressure and generating minimal heat, sizes 023–070, length 5.7 cm, set of 9, color code: gold

Straight Shaft Burrs, cylindrical, barrel-shaped, and bud-shaped

<table>
<thead>
<tr>
<th>Size</th>
<th>Dia. mm</th>
<th>cylindrical</th>
<th>barrel-shaped</th>
<th>bud-shaped</th>
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<td></td>
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<td>length 7 cm</td>
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<td>–</td>
<td>262561</td>
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<td>263050</td>
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<tr>
<td>070</td>
<td>7</td>
<td>265070</td>
<td>–</td>
<td>263070</td>
</tr>
</tbody>
</table>
Burrs and Accessories

LINDEMANN **Burrs, conical, stainless, length 7 cm**

<table>
<thead>
<tr>
<th>Size</th>
<th>Diameter mm</th>
<th>Conical sterilizable</th>
</tr>
</thead>
<tbody>
<tr>
<td>018</td>
<td>1.8</td>
<td>263518</td>
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<tr>
<td>021</td>
<td>2.1</td>
<td>263521</td>
</tr>
<tr>
<td>023</td>
<td>2.3</td>
<td>263523</td>
</tr>
</tbody>
</table>

**Burrs Accessories**

280090  **Size Template**, for drills, stainless steel, sterilizable

280080  **Brush**, for cleaning atraumatic jaws, sterilizable, package of 5

280120  **Temporal Bone Holder**, bowl-shaped, with 3 fixation screws for tensioning the petrosal bone and with evacuation tube for irrigation liquid
Accessories for Burrs

280030 Rack, for 36 straight shaft burrs with a length of 7 cm, foldable, sterilizable, size 22 x 11.5 x 2 cm

280030 K Metal Bar, for fixation at Rack 280030, to hold 18 burrs with a length of 7 cm and 16 burrs with a length of 5.7 cm, size 16 x 2.5 x 1 cm

280033 Rack, for 36 straight shaft burrs with a length of 9.5 cm, foldable, sterilizable, size 22 x 14 x 2 cm

280034 Rack, for 36 straight shaft burrs with a length of 12.5 cm, foldable, sterilizable, size 22 x 17 x 2 cm

NEW 280035 Rack, for 54 straight shaft burrs with a length of 5 cm (36 pieces) and 7 cm (18 pieces), foldable, sterilizable, size 22 x 12.5 x 3 cm

NEW 280040 Rack, flat model, to hold 21 straight shaft burrs with a length of up to 6 cm (6 pcs) and 7 cm (15 pcs), folding model, sterilizable, size 17.5 x 9.5 x 1.2 cm

NEW 280043 Rack, flat model, to hold 21 straight shaft burrs with a length of 7 cm (6 pcs) and 9.5 cm (15 pcs), folding model, sterilizable, size 17.5 x 11.5 x 1.2 cm

Please note: The burrs displayed are not included in the rack.
Accessories for Burrs

39552 A  **Wire Tray**, provides safe storage of accessories for KARL STORZ drilling/grinding systems during cleaning and sterilization, includes tray for small parts, for use with Rack 280030, rack **not included**

*for storage of:*
- Up to 6 drill handpieces
- Connecting cable
- EC micro motor
- Small parts

39552 B  **Wire Tray**, provides safe storage of accessories for KARL STORZ drilling/grinding systems during cleaning and sterilization, includes tray for small parts, for use with Rack 280030, rack **included**

*for storage of:*
- Up to 6 drill handpieces
- Connecting cable
- EC micro motor
- Up to 36 drill bits and burrs
- Small parts

**Please note:** The instruments displayed are not included in the sterilizing and storage trays.
UNIDRIVE® S III ENT SCB
High-Speed Handpieces, angled, 100,000 rpm

For use with High-Speed Drills, shaft diameter 3.17 mm
and with High-Speed Micro Motor 20712033

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
UNIDRIVE® S III ENT SCB
High-Speed Handpieces, angled and straight, 60,000 rpm

For use with High-Speed Drills, shaft diameter 2.35 mm
and with High-Speed Micro Motor 20712033

20712033

High-Speed Handpiece, extra short, angled, 60,000 rpm,
for use with High-Speed Micro-Motor 20712033

252660

5.5 mm
31 mm
High-Speed Handpiece, short, angled, 60,000 rpm,
for use with High-Speed Micro-Motor 20712033

252661

5.5 mm
51 mm

252690

5.5 mm
31 mm
High-Speed Handpiece, extra short, straight, 60,000 rpm,
for use with High-Speed Micro-Motor 20712033

252691

5.5 mm
51 mm
High-Speed Handpiece, short, straight, 60,000 rpm,
for use with High-Speed Micro-Motor 20712033
UNIDRIVE® S III ENT SCB
High-Speed Standard Burrs, High-Speed Diamond Burrs

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

<table>
<thead>
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<th>short</th>
<th>medium</th>
</tr>
</thead>
<tbody>
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<td>350110 M</td>
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<td>2</td>
<td>350120 S</td>
<td>350120 M</td>
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<td>3</td>
<td>350130 S</td>
<td>350130 M</td>
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<td>4</td>
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<td>350140 M</td>
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<td>7</td>
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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>
</tr>
</thead>
<tbody>
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<td>350210 M</td>
</tr>
<tr>
<td>2</td>
<td>350220 S</td>
<td>350220 M</td>
</tr>
<tr>
<td>3</td>
<td>350230 S</td>
<td>350230 M</td>
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<tr>
<td>4</td>
<td>350240 S</td>
<td>350240 M</td>
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<td>350250 M</td>
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<td>350260 M</td>
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<tr>
<td>7</td>
<td>350270 S</td>
<td>350270 M</td>
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**UNIDRIVE® S III ENT SCB**

High-Speed Diamond Burrs, High-Speed Acorns, High-Speed Barrel Burrs, High-Speed Neuro Fluted Burr

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

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>Short</th>
<th>Medium</th>
</tr>
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<td>350330 M</td>
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<td>350340 M</td>
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<td>350360 M</td>
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<tr>
<td>7</td>
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High-Speed Coarse Diamond Burrs, 100,000 rpm, for single use, sterile, package of 5

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

<table>
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<th>Diameter in mm</th>
<th>Short</th>
<th>Medium</th>
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<td>9.1</td>
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<td>350991 M</td>
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High-Speed Barrel Burrs, 100,000 rpm, for single use, sterile, package of 5

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<th>Short</th>
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<tr>
<td>3</td>
<td>350730 S</td>
<td>350730 M</td>
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</table>
UNIDRIVE® S III ENT SCB
High-Speed Standard Burrs, High-Speed Diamond Burrs

For use with High-Speed Handpieces, 60,000 rpm

<table>
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<th>short</th>
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<td>330130 S</td>
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<td>330160 S</td>
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<table>
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<th>short</th>
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<tr>
<td>5</td>
<td>330250 ES</td>
<td>330250 S</td>
</tr>
<tr>
<td>6</td>
<td>330260 ES</td>
<td>330260 S</td>
</tr>
<tr>
<td>7</td>
<td>330270 ES</td>
<td>330270 S</td>
</tr>
</tbody>
</table>
## UNIDRIVE® S III ENT SCB
High-Speed Diamond Burrs, High-Speed Cylinder Burrs, LINDEMANN High-Speed Fluted Burrs

For use with High-Speed Handpieces, 60,000 rpm

### 60,000 rpm diameter 5.5 mm

| 252660 | 252661 | 252690 | 252691 |

#### High-Speed Coarse Diamond Burrs, 60,000 rpm, for single use, sterile, package of 5

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>extra short</th>
<th>short</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>330330 ES</td>
<td>330330 S</td>
</tr>
<tr>
<td>4</td>
<td>330340 ES</td>
<td>330340 S</td>
</tr>
<tr>
<td>5</td>
<td>330350 ES</td>
<td>330350 S</td>
</tr>
<tr>
<td>6</td>
<td>330360 ES</td>
<td>330360 S</td>
</tr>
<tr>
<td>7</td>
<td>330370 ES</td>
<td>330370 S</td>
</tr>
</tbody>
</table>

#### High-Speed Cylinder Burrs, 60,000 rpm, for single use, sterile, package of 5

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>extra short</th>
<th>short</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>330440 ES</td>
<td>330440 S</td>
</tr>
<tr>
<td>6</td>
<td>330460 ES</td>
<td>330460 S</td>
</tr>
</tbody>
</table>

#### LINDEMANN High-Speed Fluted Burrs, 60,000 rpm, for single use, sterile, package of 5

<table>
<thead>
<tr>
<th>Size in mm (diameter x length)</th>
<th>extra short</th>
<th>short</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter 2.1/11</td>
<td>330511 ES</td>
<td>330511 S</td>
</tr>
<tr>
<td>Diameter 2.3/26</td>
<td>330526 ES</td>
<td>330526 S</td>
</tr>
</tbody>
</table>
**IMAGE1 S Camera System**

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

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

**Dashboard**

**Live menu**

**Intelligent icons**

**Side-by-side view**: Parallel display of standard image and Visualization mode
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

IMAGE1 S Camera System NEW

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

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

FULL HD image

CLARA

FULL HD image

CHROMA

FULL HD image

SPECTRA A*

FULL HD image

SPECTRA B**

* SPECTRA A: Not for sale in the U.S.
** SPECTRA B: Not for sale in the U.S.
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

**IMAGE1 S Camera System**

**TC 200EN**

**TC 200EN**

- **IMAGE1 S CONNECT**, connect module, for use with up to 3 link modules, resolution 1920 x 1080 pixels, with integrated KARL STORZ-SCB and digital Image Processing Module, power supply 100–120 VAC/200–240 VAC, 50/60 Hz including:
  - **Mains Cord**, length 300 cm
  - **DVI-D Connecting Cable**, length 300 cm
  - **SCB Connecting Cable**, length 100 cm
  - **USB Flash Drive**, 32 GB, USB silicone keyboard, with touchpad, US

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

**Specifications:**

<table>
<thead>
<tr>
<th>HD video outputs</th>
<th>Format signal outputs</th>
<th>USB interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 2x DVI-D</td>
<td>1920 x 1080p, 50/60 Hz</td>
<td>4x USB, (2x front, 2x rear)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensions w x h x d</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>305 x 54 x 320 mm</td>
<td>2.1 kg</td>
</tr>
</tbody>
</table>

For use with IMAGE1 S

**IMAGE1 S CONNECT Module TC 200EN**

**TC 300**

**TC 300**

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

**Specifications:**

<table>
<thead>
<tr>
<th>Camera System</th>
<th>TC 300 (H3-Link)</th>
</tr>
</thead>
<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) <strong>22220055-3, 22220056-3, 22220053-3, 22220060-3, 22220061-3, 22220054-3, 22220085-3</strong> (compatible without IMAGE1 S technologies CLARA, CHROMA, SPECTRA*)</td>
</tr>
<tr>
<td>LINK video outputs</td>
<td>1x</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–120 VAC/200–240 VAC</td>
</tr>
<tr>
<td>Power frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Protection class</td>
<td>I, CF-Defib</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>305 x 54 x 320 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>1.86 kg</td>
</tr>
</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 IMAGE 1 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

**20200131**

**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>
</tr>
<tr>
<td>Image sensor</td>
<td>3x 1/3&quot; CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>45 x 50 x 60 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>240 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>C-MOUNT connection</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.9/1.4 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>C-MOUNT connection</td>
</tr>
<tr>
<td>Cable</td>
<td>detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>900 cm</td>
</tr>
</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

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)

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®

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

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

System Components

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

- **209330 45** QUINTUS® L 45 TV Adaptor, for LEICA Microsystems operating microscopes, f = 45 mm, recommended for H3-M microscope camera head

- **209330 55** 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

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

- **209330 00 Z** QUINTUS® Zoom TV Adaptor, for LEICA Microsystems operating microscopes, with variable focal length f = 43 – 86 mm, for use with all KARL STORZ cameras (SD and HD)

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

- **209530 45** QUINTUS® M 45 TV Adaptor, for Möller-Wedel operating microscopes, f = 45 mm, recommended for IMAGE1 HD H3-M/H3-M COVIEW camera heads

- **209530 55** 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

**Note:** Optical beamsplitters for other operating microscopes (i.e. LEICA or Möller-Wedel) are available directly from the manufacturers.
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

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>
<td>Product no.</td>
<td>TH 100</td>
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<tr>
<td>Image sensor</td>
<td>3x 1/3&quot; CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 114 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>270 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, f = 15–31 mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>

TH 104

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

Specifications:

<table>
<thead>
<tr>
<th>IMAGE1 FULL HD Camera Heads</th>
<th>IMAGE1 S H3-ZA</th>
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</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>TH 104</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x 1/3&quot; CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 100 mm</td>
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<tr>
<td>Weight</td>
<td>299 g</td>
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<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, f = 15–31 mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>
Monitors

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

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

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

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

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

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

### Specifications:

<table>
<thead>
<tr>
<th>KARL STORZ HD and FULL HD Monitors</th>
<th>19”</th>
<th>26”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop with pedestal</td>
<td>optional</td>
<td>optional</td>
</tr>
<tr>
<td>Product no.</td>
<td>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>
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<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>
Fiber Optic Light Cable

Fiber Optic Light Cable, with straight connector, diameter 3.5 mm, length 230 cm

Cold Light Fountain XENON 300 SCB

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
- Spare Lamp Module XENON with heat sink, 300 watt, 15 volt
- 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.
Endoscope-Assisted Retrosigmoid Keyhole Approach (RSA) for Otoneurological Surgery

Equipment Cart

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

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

including:

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

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

**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

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