PERCUTANEOUS ENDOSCOPIC LUMBAR DISCECTOMY (PELD) and Other Thoracic and Lumbar Spinal Procedures with the SpineTIP System

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Introduction

The spectrum of surgical techniques for treating lumbar disc problems is extremely diverse. Over the decades, many different procedures have been developed and have undergone marked changes in their analysis, evaluation and acceptance, especially in the realm of minimally invasive techniques. Microsurgical technique has become the current gold standard for spinal surgery, while a number of microinvasive techniques no longer have a significant role in the modern treatment of disc herniations.

The development of new endoscopic telescopes has opened up new possibilities for percutaneous approaches. Technical innovations and improved systems have gone hand in hand with advancements in operating technique.

With the availability of endoscopic systems that integrate a high-resolution optical system, cold-light source adapters, and working and irrigation channels into a functional unit, spinal surgeons are now able to perform true minimally invasive coaxial and monoportal surgery under excellent visual control. The application of these systems and techniques is often described by the term “percutaneous endoscopic lumbar discectomy” (PELD). The SpineTIP System is an instrument set that combines the three standard percutaneous approaches – transforaminal, interlaminar and posterolateral – into one system whose endoscopes and operating instruments have been specifically designed for a particular approach.

The SpineTIP System

The SpineTIP System covers a broad spectrum of surgical indications ranging from lumbar and thoracic disc herniations to other spinal diseases such as spondylodiscitis. The anatomical observations of P. Kambin (Fig. 1) are pertinent to the posterolateral approach. While Kambin’s triangle was first used as a corridor for intradiscal surgery, today we practice an improved and established technique for working within the foramen under reliable neural control. This approach can be used on a continuum with the extreme lateral approach and the true transfornaminal approach. Aided by new oblique telescopes and deflectable grasping forceps, the transfornaminal approach allows for the effective surgical treatment of intraspinal lesions while maintaining visual control of neural structures.

Mediolateral disc herniations at the L5-S1 level that are not accessible by this route can still be visualized and removed by the interlaminar approach. Almost any disc herniation can be removed by minimally invasive or endoscopic technique by varying the different approaches that are available with the SpineTIP System. The use of high-speed burrs can expand the range of applications to the surgical treatment of degenerative spinal diseases. This technical refinement enables us to enlarge the spinal canal and neural foramen in order to relieve stenosis, decompress the exiting nerve roots, and increase transfornaminal access. The use of burrs can also expand the indications for interlaminar endoscopic surgery.

Current publications suggest that the results of sequestrectomy alone are superior to the results of microdiscectomy. If we can limit our efforts to sequestrectomy alone, then spinal endoscopic surgery becomes a logical next step in the treatment of spinal nerve root compression syndromes.

Advantages of spinal endoscopic surgery over open surgical procedures:

- Minimal access trauma
- Lesion-specific surgery
- Excellent visibility owing to continuous irrigation
- Minimal blood loss owing to continuous irrigation
- Low risk of infection owing to continuous irrigation
- Shorter operating times
- Less intraspinal scarring
- Unlimited revision options
- Independent of patient stature
- Does not destabilize the motion segment

The main disadvantages are a long learning curve and the risk of access-related injury to exiting nerve roots. But at the same time, new techniques of intraoperative nerve monitoring are available that can reliably signal the proximity of the operating sheath and instruments to the nerve root in the anesthetized patient. The use of neuronavigation can also help operators become more proficient in the demanding PELD technique.

1 Schematic drawing of Kambin’s triangle.
The letters TIP in the name SpineTIP stand for the three percutaneous endoscopic approaches (Figs. 3a–c):

- **Transforaminal (a)**
- **Interlaminar (b)**
- **Posterolateral (c)**

The design of the endoscopes and instruments in the SpineTIP System is geared toward the targeted pathology inside and outside the spinal canal. The system is color-coded and limited to a few essential instruments and devices to provide a user-friendly and logically structured design.

In this monograph we will highlight the main decision-making criteria for using the SpineTIP System based on representative cases that illustrate the special range of indications for the SpineTIP subunits.

The philosophy of SpineTIP is based on an optimized, approach-specific working concept that facilitates endoscopic disc surgery and offers a variety of treatment options for percutaneous thoracic and lumbar spinal surgery.

Today there is competition between endoscopic and microsurgical techniques for the treatment of common and typical disc herniations in the lumbar spine, and so far there is no clear evidence that one technique is better than the other, especially in the long term.

Percutaneous techniques, however, are proving to be superior for special problems such as the treatment of disc herniations in the upper lumbar or thoracic spine or lateral intra- and extraforaminal sequestra. It would be presumptuous to claim that percutaneous endoscopic disc surgery will one day replace microsurgery. The goal of the SpineTIP System, rather, is to provide a logical adjunct to the current gold standard and offer effective solutions for difficult situations.

Valid clinical studies are still needed to determine the true potential of these advanced and innovative techniques.

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**Patient Positioning**

All patients are positioned prone on a radiolucent Wilson frame. The legs are flexed slightly at the hips and knees to relieve primary tension on the nerve roots and facilitate manipulations in the foramen. Facilities for biplanar fluoroscopic imaging are required.
Operating Room Setup

The surgeon and assistant stand on the same side as the targeted pathology. The fluoroscopic C-arm with monitor is on the opposite side, flanked by the video system toward the foot of the table.

If necessary, the navigation unit can be placed next to the surgeon at the head of the table, and the nerve monitoring unit can be placed at the foot of the table.

Needle Placement and Discography

Following aseptic preparation of the operative area, a needle is introduced into the disc under lateral C-arm guidance for the posterolateral and transforaminal approach. Safe and accurate needle placement at the target site is the most important step in the operation. An error at this stage may lead to loss of orientation and control at a later stage. Needle placement for specific approaches will be described in the sections below. For now, it is important to note that needle placement is always target-oriented and should be preplanned in axial sectional
images, aided if necessary by computer-assisted distance measurements. The needle trajectory should be perpendicular to the disc; it should not be angled in a cranial or caudal direction. Also, the needle tip should slide into the intervertebral foramen along the rim of the superior articular facet, always staying in contact with the bone, to maintain clearance from the exiting nerve root. Correct needle placement is then checked and documented in two planes. Subsequent discography yields additional information by displaying the actual pathology and can be used later to assess the efficacy of treatment (Figs. 5a–f).

Just Before Endoscopy …

When target-oriented needle placement and discography have been completed, the operative field is draped for the posterolateral and transforaminal approach with facilities ready for biplanar C-arm fluoroscopy. A guidewire is advanced through the needle into the disc. A stab incision is made in the skin, and a conical-tip dilator is advanced over the guidewire and into the disc annulus. The guidewire is removed at this point, making certain that the dilator is not moved. Two or three taps with a mallet should be sufficient to advance the dilator to the target site. Next the operating sheath is advanced over the dilator and tapped into place. The endoscope may now be introduced.
The Transforaminal Approach

This approach can be used to treat medial to mediolateral disc herniations above the lumbosacral segment using the technique described. If the iliac crest is above the level of the L4 pedicle, needle placement cannot be done with the necessary accuracy. There should be minimal cranial or caudal migration of the herniated disc material, and ideally the herniation should be at the level of the disc space. The target point is the posterior one-fifth of the disc in the median plane. The needle entry site is determined on axial images (Figs. 8a, b)

This approach avoids direct entry into the spinal canal and thus minimizes the risk of iatrogenic dural injury. The trajectory of the endoscope allows for safe exploration of the epidural space after sequestra have been removed. Generally it is unnecessary to enlarge the foramen with a burr, which is not without risk. Endoscopy is performed under fluoroscopic guidance in the AP projection. As the operating sheath and endoscope are retracted, their relationship to neural structures can be appreciated by using, say, the medial border of the pedicle as a reference point. We recommend the operating sheath with a straight bevel and distal slot. The anatomical characteristics of the upper lumbar spine, with its large neural foramina, increase the action radius in this region. Intraspinal lesions can be approached at a steeper angle, eliminating the risk of potential iatrogenic injury to intra- and extraperitoneal organs. All cases require individual planning that takes into account local anatomy and pathology (illustrative case, Figs. 9a–e).

Preoperative determination of the target site and needle entry point.

MRI appearance of an L4-5 mediolateral disc herniation that is an ideal indication for transforaminal endoscopic sequestrectomy.

Corresponding endoscopic views clearly demonstrate the sequestrum after partial removal of the elevated posterior longitudinal ligament (c, d). After sequestrectomy, the epidural space is visualized with the HOPKINS® II 25° telescope through the perforation (e).
The Interlaminar Approach

Under AP fluoroscopic control, the site for the stab incision is marked using a sterile pen in the area of surgical access covered by sterile drapes. The skin entry point is paramedial and the approach is targeted on the lateral border of the interlaminar window. When the skin has been incised and the dilator advanced to the target point, the slotted and beveled operating sheath is introduced. The endoscope is inserted, and the ligamentum flavum is visualized. The ligament is fenestrated and the access portal is enlarged with micro punches. Fatty tissue will generally come into view, signaling entry into the epidural space. The operating sheath with the long, proximally beveled distal tip is then advanced through the windowed approach with short rotary movements, directing the tip laterally and keeping it close to the articular facet. The dural sac and nerve roots should be clearly visualized during this maneuver. The surgeon may work over the shoulder or the axilla, depending on individual anatomy. The long bevel is now rotated medially to serve as a retractor for the nerve roots and dural sac. The C-arm is turned to the lateral projection, and local anatomy and pathology can now be correlated with preoperative imaging (Figs. 10a, b). As in all described percutaneous techniques, irrigating fluid is delivered to the surgical site at a controlled pressure; fluid outflow is through the suction channel without additional suction or through the Luer port in the operating sheath to avoid compressive volume effects. The procedure concludes by removing the operating sheath and endoscope and suturing the skin incision (Figs. 10c–f).

![Intraoperative placement of the dilator and operating sheath at the lateral edge of the interlaminar window.](image10a)

A small, lentil-sized incision is made in the ligamentum flavum, and ...

... the herniated disc material in the lumbosacral segment is extracted (d-f).
Percutaneous Endoscopic Lumbar Discectomy (PELD) and Other Thoracic and Lumbar Spinal Procedures with the SpineTIP System

The Posterolateral Approach

This approach gives access for intradiscal surgery if required. Intraspinal sequestra can also be removed by the iceberg principle or by the “inside-out” technique described by other authors – in which case intraspinal structures cannot be directly visualized. The target point is the center of the disc. The needle is inserted at an approximately 45° angle; this trajectory provides the safest foraminal approach (Figs. 11a, b). When the operating sheath and endoscope have been placed at the center of the disc, intra- and extraforaminal disc herniations are addressed by slowly retracting the endoscope along the herniation tract with a twisting motion until the annulus is reached. Central and peripheral fragments can be grasped and removed under vision. Most sequestra are too large to be removed through the endoscope working channel; they can be grasped and removed from the working sheath along with the endoscope.

Target-oriented needle placement is also important for the posterolateral approach. Axial images show the close proximity of the needle path to the articular facet.

Navigation-assisted view of the “foraminal retreat” (correlative pairs of endoscopic and axial-CT images aa’, bb’ and cc’).
The most important part of the operation, foraminoscopy, begins now:

The unslotted operating sheath is retracted from the annulus, keeping close to the posterior bony rim, and is positioned in the foramen. Free, perforated disc fragments may prolapse into the distal end of the sheath at this time and can be removed. Contained sequestra should be dissected while sparing the nerve root, which generally are displaced laterally by the operating sheath. As the operating sheath is retracted further, the nerve root comes into view; the surgeon may even see the peripheral nerve distal to the ganglion passing obliquely through the operative field. Positive identification is difficult but imperative. The tubular part of the nerve is surrounded by loose fat and muscle tissue. Again, the distal end of the unslotted operating sheath can be used to push aside soft-tissue structures that hamper vision. As experience is gained and the procedure becomes more routine, the surgeon will be able to expose the nerve roots from the visible portion of the axilla to the site where they cross the disc. All disc herniations in and outside the foramen can be treated by this technique, called the “foraminal retreat.” Purely extraforaminal sequestra require only this “retreat” from the center of the disc without special positioning at the foramen. Caudal extraforaminal sequestra are extremely rare (Figs. 12a–f).

If orientation is lost during this procedure, it can be regained by reintroducing the dilator into the disc through the existing tract, keeping it in contact with the articular facet. The operating sheath and endoscope are then reinserted as previously described (illustrative case, Figs. 13a–c).
Endoscopic Approach to the Thoracic Spine

The posterolateral endoscopic approach to the thoracic spine can be used as an alternative to the open transfacet approach or costotransversectomy. The posterolateral approach is appropriate for soft lateral to intraforaminal sequestra, and CT imaging may be needed to distinguish these soft lesions from hard, calcified sequestra. Success also depends critically on preoperative planning based on axial images from sectional modalities with corresponding distance measurements from the pleura. Otherwise the procedure is basically the same as in the posterolateral approach described above. The needle is advanced obliquely downward along the superior rib margin to the center of the disc (Fig. 14). The endoscope is placed, and the “foraminal retreat” maneuver is used to access the pathology (illustrative case, Figs. 15a–d).

14 Posterolateral needle placement demonstrated in a skeletal model.

15 Large foraminal disc herniation at T12-L1. Retraction of the endoscope brings the sequestrum into view (c). Removal of sequester is followed by radiofrequency ablation of unstable epidural disc material (d).
Expanded Indications

1. Endoscopic debridement with placement of antibiotic beads and percutaneous stabilization with internal fixation plates in a patient with florid thoracic spondylodiscitis.

2. Endoscopic extirpation of a foraminal juxtafacet cyst. After the “foraminal retreat” and cyst removal, the exiting nerve root is positively identified and decompressed in the ganglion region.
3. Endoscopic resection of an L3 vertebral body tumor with mechanical excavation and radiofrequency ablation. Histology revealed a benign connective-tissue process following prior radiotherapy for breast cancer.

5. Percutaneous endoscopic drainage of a psoas abscess with irrigation of the abscess cavity.
Perioperative Neuromonitoring

Necessary manipulations in the neural foramen pose a hazard to the exiting nerve and, in the lateral transforaminal approach, to the traversing nerve as well. In principle, the procedures can be done under local anesthesia so that the patient’s pain response can provide feedback on proximity to neural structures. But to spare the patient’s nerves as well as the surgeon’s, the author prefers to use general anesthesia combined with perioperative electrophysiologic neuromonitoring.

Needle myography of indicator muscles during the operation provides a continuous readout of potentials in a technique known as free-run electromyography. Certain potential patterns such as A-trains may be recognized during the procedure as indicators of mechanical nerve irritation.

Based on a monitoring technique used for eXtreme Lateral Interbody Fusion (XLIF), surface electrodes and neurostimulation can provide even more reliable nerve monitoring. The puncture needle is placed and the dilator is advanced to the disc annulus as usual. The dilator is then replaced by a stimulator rod of similar shape that is also advanced over the guidewire into the foramen. At this point brief stimuli are applied (Figs. 21a–c) and the responses activate a “traffic light” signal indicating proximity to the foraminal nerve. In this way the needle placement can still be adjusted if needed before the actual operation begins. Additionally, continuous monitoring and documentation by free-run electromyography may be used throughout the procedure.

Placement of surface electrodes for stimulation EMG (a, b). Electrical stimuli are administered through the rod in the foramen (c).

Nerve monitoring with an on-screen documentation system (a–c).
Navigation

Surgical navigation can provide improved, multidimensional orientation for spinal endoscopy. The technique shown here is based on “CT-fluoro matching.” In this technique the acquired CT data set is correlated with the C-arm image in two planes after a reference clamp has been placed on the spinous process at the affected level. Various instruments including the endoscope can then be calibrated for intraoperative navigation.

After digital data are correlated with the current C-arm image, instruments and endoscopes can be calibrated and then navigated (a–d).
References


8. LÜBBERS T. Diagnosis and percutaneous endoscopic treatment of foraminal and extraforaminal disc herniation at the level L5/S1. International 29th Course For Percutaneous Endoscopic Spinal Surgery And Complementary Minimal Invasive Techniques. Zürich; 2011


Percutaneous Endoscopic Lumbar Discectomy (PELD) and Other Thoracic and Lumbar Spinal Procedures with the SpineTIP System

SpineTIP – Percutaneous Lumbar Endoscopic System for the Transforaminal, Interlaminar and Posterolateral Approach
SpineTIP – Percutaneous Lumbar Endoscopic System
for the Transforaminal Approach
Basic Set
**SpineTIP – Percutaneous Lumbar Endoscopic System for the Transforaminal Approach**

**Basic Set**

1. 28163 PEL **Puncture Needle**, long, diameter 1.7 mm, working length 25 cm, with 1.4 mm opening for guide wire
2. 28163 GWL **Guide Wire**, blunt, diameter 1.1 mm, working length 45 cm
3. 28163 FHT **Dilation Sleeve**, outer diameter 6.5 mm, inner diameter 1.4 mm, length 31 cm, with two ports, for the transforaminal approach, color code: blue
4. 28163 CM **COTTLÉ Mallet**, with Nylon replacement, length 22.5 cm
5. 28163 FEH **Punch Sleeve**, for use with operating sheaths
6. 28163 FKD **Fixation Handle**, for adjustment of dilation sleeves with outer diameter 2.5–6.5 mm (not illustrated)
7. 28163 TSG **Operating Sheath**, graduated, distal straight, integrated irrigation connector, inner diameter 6.8 mm, outer diameter 7.8 mm, length 25 cm, for use with HOPKINS® Wide Angle Straight Forward Telescope 25°, 28163 BTA, color code: blue
8. 28163 TSN **Operating Sheath**, graduated, with distal beak, integrated irrigation connector, inner diameter 6.8 mm, outer diameter 7.8 mm, length 25 cm, for use with HOPKINS® Wide Angle Straight Forward Telescope 25°, 28163 BTA, color code: blue
9. 28163 TSW **Operating Sheath**, graduated, distal oblique, integrated irrigation connector, inner diameter 6.8 mm, outer diameter 7.8 mm, length 25 cm, for use with HOPKINS® Wide Angle Straight Forward Telescope 25°, 28163 BTA, color code: blue
10. 28163 BTA **HOPKINS® Wide Angle Straight Forward Telescope 25°**, angled eyepiece, diameter 6.6 mm, length 25.5 cm, autoclavable, with fiber optic light transmission incorporated and working channel for 3.5 mm instruments, color code: blue
11. 495 NA **Fiber Optic Light Cable**, with straight connector, diameter 3.5 mm, length 230 cm (not illustrated)
12. 28163 FBC *Bipolar Electrode, angled*, diameter 2.5 mm, working length 36 cm
13. 28163 UH **Palpation Hook**, distally angled 45°, diameter 2 mm, working length 34 cm
14. 28163 FDW **Dissector**, diameter 2.6 mm, working length 36 cm, distal end curved 45°
15. 28163 FDG **Dissector**, diameter 2.6 mm, working length 36 cm, distal end curved 90°
16. 28163 FBH **CLICKLINE Palpation Hook**, rotating, bendable to 90°, with distal ball, diameter 3.5 mm, working length 36 cm
17. 28163 FZ **Grasping Forceps**, single action jaws, with 90° angle of view, diameter 3.5 mm, working length 36 cm
18. 28163 FBM **Grasping Forceps**, double action jaws, diameter 2.7 mm, working length 36 cm
19. 28163 FZI **CLICKLINE Raven’s Beak Forceps**, rotating, single action jaws, diameter 3.5 mm, working length 36 cm
20. 28163 FSI **CLICKLINE BLAKESLEY Grasping Forceps**, rotating, single action jaws, fenestrated, size 3 mm, length 36 cm
21. 28163 FM **Knife**, retractable, diameter 3.5 mm, working length 36 cm

**Recommended Containers for Sterilization:**

- Telescopes: 39314 G
- Instruments: 39360 BK

* The bipolar probe insert can be ordered separately with the reference no. 28163 FBE.

Depending on the device used, please add a bipolar High Frequency Cord e. g. 26176 LE
SpineTIP – Percutaneous Lumbar Endoscopic System for the Interlaminar Approach

Basic Set
SpineTIP – Percutaneous Lumbar Endoscopic System
for the Interlaminar Approach

Basic Set

1. **28163 PL** Puncture Needle, including stylet, diameter 1.7 mm, working length 18 cm, with 1.4 mm opening for guide wire
2. **28163 GW** Guide Wire, blunt, diameter 1.1 mm, working length 31 cm
3. **28163 FHI** Dilation Sleeve, outer diameter 6.5 mm, inner diameter 1.4 mm, working length 22 cm, with two ports, color code: red
4. **28163 CM** COTTEL Mallet, with Nylon replacement, length 22.5 cm
5. **28163 FKD** Fixation Handle, for adjustment of dilation sleeves with outer diameter 2.5–6.5 mm (not illustrated)
6. **28163 FEH** Punch Sleeve, for use with operating sheaths
7. **28163 FSG** Operating Sheath, graduated, distal straight, with clamp mechanism for fixation, integrated irrigation connector, inner diameter 7.2 mm, outer diameter 7.9 mm, working length 18 cm, color code: red
8. **28163 FSN** Operating Sheath, graduated, distal beak, with clamp mechanism for fixation, integrated irrigation connector, inner diameter 7.2 mm, outer diameter 7.9 mm, working length 18 cm, for use with HOPKINS® Wide Angle Straight Forward Telescope 25° 28163 BFA, color code: red
9. **28163 FSW** Operating Sheath, graduated, distal oblique, with clamp mechanism for fixation, integrated irrigation connector, inner diameter 7.2 mm, outer diameter 7.9 mm, length 18 cm, color code: red
10. **28163 BFA** HOPKINS® Wide Angle Straight Forward Telescope 25°, oblique view, outer diameter 6.6 mm, length 18 cm, autoclavable, fiber optic light transmission incorporated and 3.5 mm working channel, color code: red
11. **495 NA** Fiber Optic Light Cable, with straight connector, diameter 3.5 mm, length 230 cm (not illustrated)
12. **28163 FBC** Bipolar Electrode, angled, diameter 2.5 mm, working length 36 cm
13. **28163 FM** Knife, retractable, diameter 3.5 mm, working length 36 cm
14. **28163 FBH** CLICKLINE Palpation Hook, rotating, bendable to 90°, with distal ball, diameter 3.5 mm, working length 36 cm
15. **28163 UH** Palpation Hook, hook angled 45°, diameter 2 mm, working length 34 cm
16. **28163 FDW** Dissector, diameter 2.6 mm, working length 36 cm, distal end curved 45°
17. **28163 FDG** Dissector, diameter 2.6 mm, working length 36 cm, distal end curved 90°
18. **28163 FBM** Grasping Forceps, double action jaws, diameter 2.7 mm, working length 36 cm
19. **28163 FZ** Grasping Forceps, single action jaws, with 90° angle of view, diameter 3.5 mm, working length 36 cm
20. **28163 FZI** CLICKLINE Raven’s Beak Forceps, rotating, single action jaws, diameter 3.5 mm, working length 36 cm
21. **28163 FSI** CLICKLINE BLAKESLEY Grasping Forceps, rotating, single action jaws, fenestrated, size 3 mm, length 36 cm
22. **28163 FPW** SpinoFIT Punch, distal 45°, working length 30 cm
23. **28163 FPG** SpinoFIT Punch, distal 90°, working length 30 cm
24. **28163 FTK** Trephine, outer diameter 4.2 mm, inner diameter 3.2 mm, working length 18.5 cm
25. **28163 FTG** Trephine, outer diameter 8 mm, inner diameter 7 mm, working length 18 cm
26. **28163 FTM** Trephine, with pyramidal handle, outer diameter 2.7 mm, inner diameter 1.6 mm, working length 30 cm

Recommended Containers for Sterilization:
Telescopes: 39314 G
Instruments: 39360 BK

* The bipolar probe insert can be ordered separately with the reference no. 28163 FBE. Depending on the device used, please add a bipolar High Frequency Cord e. g. 26176 LE
SpineTIP – Percutaneous Lumbar Endoscopic System for the Posterolateral Approach
Basic Set
## SpineTIP – Percutaneous Lumbar Endoscopic System for the Posterolateral Approach

### Basic Set

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<th>Item Description</th>
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<td>Palpation Hook, distally angled 45°, diameter 2 mm, working length 34 cm</td>
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<td>28163 SL</td>
<td>TAKE-APART® Grasping Forceps, diameter 2.3 mm, working length 30 cm</td>
<td></td>
</tr>
<tr>
<td>28163 FBM</td>
<td>Grasping Forceps, double action jaws, diameter 2.7 mm, working length 36 cm</td>
<td></td>
</tr>
<tr>
<td>28163 FBG</td>
<td>CLICKLINE Palpation Hook, rotating, dismantling, not insulated, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, with distal ball, bendable to 90°, diameter 2.7 mm, working length 36 cm (not illustrated)</td>
<td></td>
</tr>
<tr>
<td>28163 FTK</td>
<td>Trehpaine, outer diameter 4.2 mm, inner diameter 3.2 mm, working length 18.5 cm</td>
<td></td>
</tr>
<tr>
<td>28163 FTG</td>
<td>Trehpaine, outer diameter 8 mm, inner diameter 7 mm, working length 18 cm</td>
<td></td>
</tr>
<tr>
<td>28163 FTM</td>
<td>Trehpaine, with pyramidal handle, outer diameter 2.7 mm, inner diameter 1.6 mm, working length 30 cm</td>
<td></td>
</tr>
</tbody>
</table>

### Recommended Containers for Sterilization:

- Telescopes: 39314 G
- Instruments: 39360 BK

* The bipolar probe insert can be ordered separately with the reference no. 28163 FBE. Depending on the device used, please add a bipolar High Frequency Cord e. g. 26176 LE
UNIDRIVE® S III NEURO SCB
Recommended Standard Set Configurations

40 7017 01-1 UNIDRIVE® S III NEURO SCB, motor control unit with color display, touch screen, two motor outputs, integrated irrigation pump and integrated SCB module, power supply 100 – 240 VAC, 50/60 Hz including:

- Mains Cord
- Irrigator Rod
- Two-Pedal Footswitch, two-stage, with proportional function
- Silicone Tubing Set, for irrigation, sterilizable
- Clip Set, for use with tubing set
- SCB Connecting Cable, length 100 cm
- Single Use Tubing Set*, sterile, package of 3

Specifications:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch Screen</td>
<td>6.4”/300 cd/m²</td>
</tr>
<tr>
<td>Available languages</td>
<td>English, French, German, Spanish,</td>
</tr>
<tr>
<td></td>
<td>Italian, Portuguese, Greek, Turkish,</td>
</tr>
<tr>
<td></td>
<td>Polish, Russian</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–240 VAC, 50/60 Hz</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>300 x 165 x 265 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>5.2 kg</td>
</tr>
<tr>
<td>Certified to</td>
<td>IEC 601-1, CE acc. to MDD</td>
</tr>
</tbody>
</table>

* mtp medical technical promotion gmbh,
  Take-Off GewerbePark 46, 78579 Neuhausen ob Eck, Germany
Suction Burr

The following suction burrs are offered for use with HOPKINS® 25° telescope for the interlaminar approach:

- **Suction Burr**, with integrated irrigation, straight, sterilizable, cylindrical cutter head with lateral and distal protection, shaft diameter 3.5 mm, length 30 cm, for use with DRILLCUT-X® II Spine Handpiece 28712050

DrillCut-X® II Spine Handpiece

- **287120 50** DRILLCUT-X® II Spine Handpiece, for use with UNIDRIVE® S III NEURO
AR ThomPump® Power

283407 02- 1 AR ThomPump® Power, Set, Spine
including:
AR ThomPump® Power,
power supply 100 – 240 VAC, 50/60 Hz
Mains Cord, length 300 cm
* Tubing Set Irrigation, for AR ThomPump® Power
* Tubing Set Suction, for AR ThomPump® Power
SCB Connecting Cable, length 100 cm

Specifications (for spinal applications):

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure-regulated</td>
<td>- 20 - 150 mmHg</td>
</tr>
<tr>
<td>Continuous Flow:</td>
<td>- 10 - 200 ml/min</td>
</tr>
<tr>
<td>Power supply</td>
<td>100-240 VAC, 50/60 Hz</td>
</tr>
<tr>
<td>Dimensions</td>
<td>447 x 155 x 313 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>8.8 kg</td>
</tr>
<tr>
<td>Certified to:</td>
<td>IEC 601-1, CE acc. to MDD</td>
</tr>
</tbody>
</table>

NOTE: Users in the U.S.A. are not authorized to work with procedures for spinal applications.

* mtp medical technical promotion gmbh,
  Take-Off GewerbePark 46, 78579 Neuhausen ob Eck, Germany
  Tel.: +49 (0)7467 94504-0, Fax: +49 (0)7467 945 04 99
  E-mail: info@mtp-tut.de
Percutaneous Endoscopic Lumbar Discectomy (PELD) and Other Thoracic and Lumbar Spinal Procedures with the SpineTIP System

**IMAGE1 S Camera System NEW**

**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
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

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

**SPECTRA B**: Not for sale in the U.S.
Percutaneous Endoscopic Lumbar Discectomy (PELD) and Other Thoracic and Lumbar Spinal Procedures with the SpineTIP System

**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>Power supply</th>
<th>100–120 VAC/200–240 VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 2x DVI-D</td>
<td>Power frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>- 1x 3G-SDI</td>
<td>Protection class</td>
<td>I, CF-Defib</td>
</tr>
<tr>
<td>LINK video inputs</td>
<td>Dimensions w x h x d</td>
<td>305 x 54 x 320 mm</td>
</tr>
<tr>
<td>USB interface</td>
<td>Weight</td>
<td>2.1 kg</td>
</tr>
<tr>
<td>SCB interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4x USB, (2x front, 2x rear)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2x 6-pin mini-DIN</td>
<td></td>
<td></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)</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.
Percutaneous Endoscopic Lumbar Discectomy (PELD) and Other Thoracic and Lumbar Spinal Procedures with the SpineTIP System

*NEW*

**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

<table>
<thead>
<tr>
<th>Specifications:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IMAGE1 FULL HD Camera Heads</strong></td>
</tr>
<tr>
<td>Product no.</td>
</tr>
<tr>
<td>Image sensor</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Optical interface</td>
</tr>
<tr>
<td>Min. sensitivity</td>
</tr>
<tr>
<td>Grip mechanism</td>
</tr>
<tr>
<td>Cable</td>
</tr>
<tr>
<td>Cable length</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,
- Color systems: PAL/NTSC
- Max. screen resolution: 1920 x 1080
- Image format: 16:9
- Power supply: 100–240 VAC, 50/60 Hz
- Wall-mounted with VESA 100 adaption
- Including:
  - External 24 VDC Power Supply
  - Mains Cord
Monitors

**KARL STORZ HD and FULL HD Monitors**

<table>
<thead>
<tr>
<th>Model</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor</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&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>
Percutaneous Endoscopic Lumbar Discectomy (PELD) and Other Thoracic and Lumbar Spinal Procedures with the SpineTIP System

**AUTOCON® II 400 SCB**

20535201-125 AUTOCON® II 400 High End, Set SCB

- Power supply 220 - 240 VAC, 50/60 Hz
- HF connecting sockets: Bipolar combination, Multifunction, Unipolar 3-pin + Erbe Neutral electrode combination 6.3 mm, jack and 2-pin
- System requirements: SCB R-UI Software Release 20090001-43 or higher

Including:
- AUTOCON® II 400, with KARL STORZ SCB Mains Cord
- SCB Connecting Cable, length 100 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 Cord, length 100 cm
- Spare Lamp Module XENON
- XENON Spare Lamp, only,
  - 300 watt, 15 volt

**Fiber Optic Light Cable**

495 NA Fiber Optic Light Cable

- With straight connector, diameter 3.5 mm, length 230 cm
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.
Percutaneous Endoscopic Lumbar Discectomy (PELD) and Other Thoracic and Lumbar Spinal Procedures with the SpineTIP System

Equipment Cart

![Equipment Cart Image](image1)

**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

**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 Image](image2)

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

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

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

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