Transforaminal endoscopic access path for the treatment of herniated discs and stenosis
Endoscopic surgery has been a routine procedure in laparoscopy and arthroscopy since the 1980s. The neuro and cardiac surgery endoscopic minimally invasive techniques were first introduced in the 1990s. The last decade has seen a significant evolution of the minimally invasive procedures for spinal surgery which lessen post-operative pain, damage fewer structures and involve the removal of less soft tissue. Faster recovery is then possible. Ongoing technological advances have resulted in increasingly sophisticated surgical approaches for disease-specific treatment and ultimately allowed endoscopic spinal surgery to become a reality.

“Endoscopic techniques may speed recovery, minimize post-operative pain, and improve the final outcome. Healing processes which once took three to six months now require no more than three to six weeks!”

The Cleveland Clinic Foundation

Pioneers in Endoscopic Spine Surgery

Minimally invasive spinal surgery has developed into an alternative and safe procedure for a range of spinal column disorders. The surgical technique is particularly suitable for discectomy, the treatment of herniated discs or to stabilize unstable spinal column segments. Mixter, Barr, and Dandy are known for their work on the diagnosis and treatment of herniated discs and for using laminectomy to expose the lumbar spinal canal. Surgeons have been looking for alternative techniques to laminectomy and discectomy for more than 50 years, techniques such as removal of the nucleus by means of anterior retroperitoneal access, automated percutaneous nucleotomy, applying suction excision for lumbar herniated discs, chemonucleolysis or laser ablation.

In the 1970s, Parviz Kambin and Sadahisa Hijikata began performing surgery using cannulas specially designed for percutaneous dorsolateral nucleotomy and achieved a documented success rate of 75% for their technique. In the 1980s, the principle of mechanical nucleotomy was further advanced by other physicians.

Today’s advanced endoscopic understanding of the anatomy of the intra and extraforaminal zones and Kambin’s radiological determination of orientation points for the working zone around the dorsolateral area of the annulus, combined with the ready availability of smaller endoscopes, have made lateral access possible.

The TESSYS® method uses a lateral transforaminal endoscopic access path to remove disc herniation. It is known to be a particularly gentle method for patients. Disc herniation or sequestered disc material is removed via direct access through the foramen, which is gradually dilated with special reamers and instruments. The patient is in a stable lateral or prone position during the procedure and responsive throughout surgery under analgesic sedation. The TESSYS® surgical procedure is performed in hospitals and outpatient centers, and reimbursed in Germany.

Benefits for patients:
- Minimal destabilization
- Minimal traumatization
- Hardly any scar tissue
- Very rapid recovery
Almost all herniated discs and free sequesters can be treated with the combination of the TESSYS® method with TESSYS® technology, regardless of their position, including L5-S1. The surgical procedure uses the lateral transfornaminal access and can be performed under analgesic sedation.

All radicular symptoms caused by herniated discs that have not improved with conservative management are indications for surgery with the TESSYS® surgical procedure. An indication of cauda equina syndrome requires immediate surgical intervention. Every surgical procedure on a spinal disc, including TESSYS® surgery, has to be planned carefully using Magnetic Resonance Imaging (MRI) and/or Computed Tomography (CT), and multiple conventional X-ray images.

For some patients, the exact position of the herniated disc can be identified intraoperatively with chromography and displayed as colored disc tissue.

Publications and studies on endoscopic spinal surgery are increasingly featured in international medical literature. There are many obvious advantages of endoscopic surgery, McAfee et al., for instance, showed that there is a considerably lower risk of infection in comparison to open surgery (Fig. bottom left). In a randomized study, Gibson et al. compared the transfornaminal endoscopic disc operation to the micro-surgical operating procedure. Both patient groups benefited from the operation, although after two years, pain in the more strongly affected leg was significantly lower in the group of patients who had been treated endoscopically (Fig. bottom right).
Correct positioning of the patient and careful planning of the main point of access to the herniated disc are crucial for good surgical results.

Direct access to the herniated disc is gained through the intervertebral foramen from which nerve root exit. The intervertebral foramen can be anatomically narrow depending on its position (L1-L5) and age of the patient. To ensure safe access to the spinal canal and avoid irritation of the nerves in the foramen, entry is made through the caudal part of the foramen, which is widened millimeter by millimeter using special reamers (see also Product Usage Guide).

The access points are assessed laterally. The entry point for L3-L4 is approx. 8 - 10 cm (3.15 - 3.93 inches), for L4-L5 approx. 10 - 12 cm (3.93 - 4.72 inches), and L5-S1 it is approx. 12 - 14 cm (4.72 - 5.51 inches) from the middle of the back.

The figures illustrate the dorsal, lateral, and axial views of the entry angle.
A 3 step guide wire concept (see Fig. left) is used to access the prolapse. The (soft) tissue path is gradually dilated under real time X-ray control, and the foramen is gradually stretched using the reamers described. This provides a safe, tissue-conserving access corridor to the spinal canal and the prolapse.

All TESSYS® instruments (guiding rods, guiding tubes, disposable reamers, and reamer ejectors) are color-coded in the logical sequence of a traffic light: green-yellow-red. The green marked instruments have the smallest diameter and the red ones the largest.

The crown reamer tothing is designed in such a way that soft tissue is not at risk when rotated in the counter-clockwise direction. As soon as the reamer meets bone, which is easily felt, clockwise rotation is applied to drill the bone.

Once the tissue and the foramen have been sufficiently stretched, loose tissue and prolapsed material can be removed with the help of specially designed gripping, cutting, and punching forceps, under full endoscopic view provided by Full HD endoscopes (foraminoscopes). Having evacuated all prolapsed fragments, an endoscopic check is performed to verify that the affected nerve root has been relieved of pressure and can move freely.

The TESSYS® surgical procedure can be learned in special training courses (see joimax® Education Program, page 10). For further information, please contact us directly, or contact your local joimax® representative.
**TESSYS® – RESULTS**

**Before surgery:**

43-year-old man: L3-L4, lateral cranial (intraforaminal)

49-year-old man: L5-S1, left caudal

L4-L5, bilateral view

**After surgery:**

Removal of the prolapse using endoscopic forceps

Exposed nerve root from 8 am to 2 pm

Exposed nerve root

Herniated disc (colored)

Herniated disc

Radio frequency probe Vaporiflex®

Exposed nerve root

**Tissue in the immediate vicinity of the nerves can be removed by working under direct endoscopic view.**
Practical and consistent: the disposable access kits
Disposable products are required in all surgeries. Aiming to make your work easier, joimax® has developed a special disposable sterile access kit. So the instruments you need are guaranteed to be to hand while simultaneously saving you time and simplifying the process of endoscopic surgery. The set contains all the disposable products you need during surgery: puncture needles, needles, reamers, syringes, dishes, marker pen, scalpel, guide wire and an endoscope sealing cap.

We provide a range of access kits with various types of reamers to suit your requirements. We differentiate between fine and coarse crown reamers, which, like the guiding rods and tubes are also color-coded for easier handling (green = 5 mm/0.2 inches, yellow = 6.5 mm/0.26 inches and red =7.5 mm/0.3 inches). Additional disposable reamers are available individually sterile packed in undersize 4 mm /0.16 inches (blue) and oversize 8.5 mm/0.33 inches (purple).

Instrument set – high precision, high durability
The TESSYS® instrument set contains all the instruments required for safe, minimally invasive access to the spinal canal and the removal of disc tissue, bone spurs, or scar tissue (gripping, cutting, and punching forceps).

joimax® Foraminoscope – a perfect view in Full HD
All foraminoscopes are available in the version C = single-cable technology (combo) or D version = ocular cone technology (ocular).

The following variants are available:
> Working length 171 mm/6.73 inches, working channel inner diameter 3.7 mm/0.15 inches or 4.7 mm/0.19 inches
outer diameter 6.3 mm/0.25 inches or 7.3 mm/0.29 inches
> XT working length 208 mm /8.19 inches, working channel inner diameter 3.7 mm/0.15 inches outer diameter of 6.3 mm/0.25 inches

All foraminoscopes have an irrigation and suction channel with an inner diameter of 1.5 mm/0.06 inches and an optical angle of 30°.

Vaporflex® RF probe
The radio frequency probe Vaporflex® is used to stop bleeding and remove scar tissue. Annular ruptures up to 3 mm/0.12 inches long are easy to seal with the tissue shrinking procedure.

We provide additional disposable materials such as the special foil for covering the patient, to contribute to good surgical outcomes. A separate tube set with Y connectors is available for the joimax® low-pressure Versicon® irrigation pump.
Resection instruments for spinal stenosis

Spinal stenosis can be treated via transforaminal access under endoscopic control. The patented joimax® crown reamers and bone drills are perfect instruments for foramen and recess stenosis surgery. The Shrill® Shaver Blades and the endoscopic crown reamers (EndoReamer) were developed for endoscopic decompression surgery of the spinal canal.

Reamers or drills – X-ray control
The caudal foramen is extended with the crown reamers and bone drills under X-ray control to create space for the working tube. Bone can be removed from the superior articular process, the pedicle, and dorsal edge of the vertebral body (Kambin’s triangle). Different sizes of crown reamers (4 - 8.5 mm/0.16 - 0.33 inches) and drills (4 - 9.5 mm/0.16 - 0.37 inches) are available for the minimally invasive, gradual expansion of the foramen. The size of the instrument is indicated by a color-code for the reamers or bar-code for the drills.

Shrill® Shaver Blades or EndoReamer – endoscopic monitoring
The joimax® Shrill® system was designed for resectioning soft and bony tissue during endoscopic spinal surgery. Even tissue very close to the nerve can be removed when working under direct endoscopic view. The blade most suitable for the surgery is selected according to the pathology and tissue – bone, joint capsule and ligament.

Color coding of attachments for easy identification:
Yellow: for working on bone close to the nerve, e.g. the diamond abrasor
Red/Purple/Blue: for removal of bone, e.g. the acorn trimmer
Green: for removal of soft tissue, e.g. the tissue resector

Reamers
Color-coded reamers, available in five sizes, are inserted using the guiding tube.

EndoReamer
The EndoReamer is used through the working channel of the endoscope.

Bone drill
The bone drills are available in a variety of sizes, the size is indicated by stripes. They are inserted using the guide wire.

Shrill® Shaver Blades
Color-coded Shaver blades are available with different tips, such as large diamond abrasor.

Shrill® Shaver handpiece
Small ergonomic handle, specially designed for spinal applications.

Bone drill in an X-ray image
EndoReamer in an X-ray image
Bone drill in the spinal canal
EndoReamer in the spinal canal
Endoscopic decompression – with special instruments that “reach around the corner”

Herniated discs or spinal stenosis, which would otherwise be very difficult to reach, can be treated in a single access operation. The secret is the flexible instruments from joimax®. Minimally invasive, gentle, and can “reach around the corner.”

TESSYS® / iLESSYS® in combination – 360° treatment of the spinal canal

2 access points – 1 target
The 360° decompression of the spinal canal

The TESSYS® and iLESSYS® program
A 360° decompression of the spinal canal under full endoscopic control is possible when both systems are combined.

iLESSYS® and iLESSYS® Delta
The iLESSYS® instrument set consists of one access tray and one resection tray. They both hold special instruments for endoscopic access through the lamina (laminotomy) or the ligamentum flavum (flavectomy). The iLESSYS® set is designed for minimally invasive treatment of disc herniation, the iLESSYS® Delta set is suitable for the treatment of central stenosis. The working length of the laminoscopes is 125 mm/4.92 inches. The Delta laminoscope has a working channel of 6 mm/0.24 inches and an outer diameter of 10 mm/0.39 inches. Thus, it is bigger than the iLESSYS® laminoscope (working channel 3.7 mm/0.15 inches, outer diameter 6.3 mm/0.25 inches).

When to use TESSYS® and when iLESSYS®?
Transforaminal access (TESSYS®) is the recommended access method to treat disc herniation, foramen stenosis, and stenosis of the ventral spinal canal. Interlaminary access is recommended for dorsal pathologies, e.g. central and recess stenosis and for dorsal disc herniation; the same applies when transforaminal access is not possible, e.g. for L5/S1 with a very high iliac crest line. Since the laminar windows are very large at L4/5 and L5/S1, few laminary structures need to be removed using iLESSYS®.
The TESSYS® surgical method permits the high-precision treatment of the spine with minimal injury to the surrounding tissue structures. This results in minor wound pain and very little scar tissue. In addition, the stability of the spine is unimpaired.

Since the technique utilizes analgesic sedation, it is suitable for all age groups and is an outpatient procedure, allowing patients to return more quickly to everyday life.

Minimally invasive access – “gentle surgery”
- Tissue-conserving surgical access due to step-by-step tissue dilation using the Seldinger technique
- Visual endoscopic control during the operation
- Minimal destabilization and traumatization
- Small incision, only minor scarring
- Reduced risk of infection
- Short recovery time and rapid return to everyday life

joimax® provides a dynamic, 3-step training concept to learn the TESSYS® surgical technique – training for the surgeon and the entire surgical team. The primary objectives of the joimax® Education Program CME (Continuing Medical Education) are:

- Hands-on training to acquire endoscopic surgery skills
- Understanding of the basic principles, opportunities and limitations of the TESSYS® technique
- Building clinical experience, knowledge gain from scientific studies
- Exchange of experience, learning from other surgeons

joimax® – EDUCATION PROGRAM

First Surgery
Operate on your own patients
- Safe and competent support by one of our reference doctors and/or a joimax® applications specialist
- Training for the entire surgical team

Cadaver Workshop
Train on surgical techniques – Step-by-Step
- Theory: Anatomy, indications/contraindications, case studies, anesthesiology, step-by-step surgical technique, instruments
- Hands-on cadaver training, tips and tricks

Visitation
Experience live procedures
- Participation in surgical operations at our reference centers
- Share experiences with surgeons, anesthesiologists, the surgical staff and speak to patients
Full HD Endoscopy Tower

The expert solution for Spinal Surgery and Neurosurgery. All devices match perfectly with one another. They are designed specifically for treatment of sensitive structures.

1 **Vitegra®**

*Visual Integration System*

- Fully integrated digital documentation system
  - Multi-functional operation and usage
  - Intuitive, due to touchscreen and voice control
  - HD quality in full-screen mode
  - Transparent – menu follows the sequence of the operation
  - HD Multi Record on 500 GB hard disk
  - HD Multi Memory in common formats, also LAN and DICOM ready

2 **Intracs®**

*Intraoperative Navigation Tracking & Control System*

With electromagnetic navigation simple and safe to any spinal target
- Fully integrated in the endoscopic tower
- Vector-Tip-Target navigation for needle-based procedures
- For endoscopic and open surgery

3 **C-Camsource® HD Twister**

Brilliant images with maximum resolution
- Single-cable technology with combo-quick connection for joimax® Full HD endoscopes
- Full HD image quality for maximum safety during surgical applications

4 **Shrill®**

*Shaver Drill System*

Multi-functional milling and resection system
- Handpieces and shaver blades specially developed for spine surgery
- Safe removal of soft tissue and bone in cases of stenosis
- The suction function ensures an unobstructed and clear view of the operating field
- Vacuum effect due to specially protected design

5 **Versicon®**

*Versatile Irrigation Control*

Multi-range rinse pump for flexibility
- Integrated spine mode for low flow and pressure
- Permanent control of flow and pressure
- Rapidly insertable, disposable tube set
- Replaceable patient lead, with check valve

6 **Endovapor®**

*Multi Radio Frequency System*

Combines a variety of different electro-surgical modes and effects
- Specially integrated programs for spine cord surgery
  - Bipolar: vaporization, coagulation
  - Monopolar: rhizotomy
  - All-in-one generator with interdisciplinary application
  - 4 sockets: 2 x monopolar, 2 x bipolar
  - Easy, intuitive touchpad operation
  - Arc control for safe application
  - Easy neutral electrode monitoring

7 **JFMS 2420 | JFMS 3220 | JFMS 2620**

*High Definition Flatscreen Monitor*

Medical Full HD TFT Displays
- Full HD resolution: 1920×1080 pixels
- Viewing angle vertical/horizontal 178°/178°
- Automatic signal detection
- Touch control panel
Further reading

1. Lee HJ, Schreiber A; Percutaneous fusion of the lumbar spine, a promising technique. In: Spine State Art Rev 6, pp 543-546, 1992

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