RICHARD WOLF

Vertebris

VERTEBRIS Lumbar-Thoracic

Full-endoscopic Spinal Instrumentation

VERTEBRIS lumbar-thoracic, full-endoscopic techniques

Table of contents

VERTEBRIS lumbar 4

Introduction 4

The full-endoscopic **trans- and extraforaminal technique** 6

- Positioning of patient 8
- Determination of lateral access route 8
- Creation of lateral access 9
- Performance of operation 12
- Creation of posterolateral access 13
- Creation of extraforaminal access 14
- Bone resection 15
- Biportal access 16

The full-endoscopic **interlaminar technique** 17

- Positioning of patient 19
- Determination of access route 19
- Creation of access 20
- Performance of operation 21
- Bone resection 24

VERTEBRIS thoracic 25

Introduction 25

The full-endoscopic **transforaminal technique** 26

The full-endoscopic **interlaminar technique** 27

VERTEBRIS basic sets

- ***VERTEBRIS*** lumbar trans-/extraforaminal basic set 28
- ***VERTEBRIS*** lumbar and thoracic interlaminar basic set 29
- ***VERTEBRIS*** COMBIDRIVE burr and shaver set 29
- ***VERTEBRIS*** universal 30
- ***VERTEBRIS*** instruments 31-40

Literature 41

Notes 42

VERTEBRIS lumbar

Introduction

Lateral approach for the full-endoscopic transforaminal operation

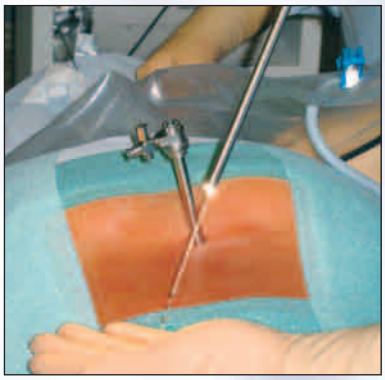
Musculoskeletal pain is one of the most common reasons for visiting the doctor. Degenerative diseases of the spine form part of daily medical practice and their treatment is complicated by medical and socioeconomic problems.

Where severe pain or neurologic deficits persist and all conservative treatment options have been exhausted, surgery may be required. Though conventional operations can achieve good results, damage may ensue due to traumatization. It is therefore important that the surgical techniques used be optimized on a continuous basis.

The latest research results and technical innovations must be critically reviewed so that optimal treatment strategies can be formulated. The aim should be to minimize surgically induced trauma and negative long-term sequelae, taking existing quality standards into account.

Minimally invasive techniques can reduce tissue damage and its consequences. Endoscopic operations with continuous irrigation have advantages that have made them the gold standard in a number of areas. Transforaminal procedures with posterolateral access have been performed in the lumbar spine for more than 20 years now, mostly for intradiscal and intra and extraforaminal procedures. In our Department of Spine Surgery and Pain Therapy we have therefore been developing a lateral transforaminal and an interlaminar approach for full-endoscopic access to the spinal canal since 1998. These approaches broaden the range of indications and permit the use in selected indications of a visually controlled procedure that is as effective as conventional surgery while benefiting from all the advantages of truly minimally invasive surgery.

Until fairly recently, the endoscopic approach was subject to technical problems in that the intraendoscopic working channel of the available optical systems was small and the repertoire of instruments that could be used was correspondingly limited. Insurmountable difficulties could arise in the resection of hard tissue and in terms of limited anatomic access and mobility. Work on the affected tissue was limited and sometimes had to be performed without direct visualization. New rod lenses with a 4.1 mm intraendoscopic working channel and corresponding new instruments, as well as shavers and burrs, were therefore developed so that full-endoscopic operations could be performed under continuous and precise visual control. This also permitted adequate bone resection. The range of indications for endoscopic spinal surgery was thus broadened to include intervertebral disc herniations, spinal canal stenosis, and stabilization techniques.



Continuous irrigation provides outstanding intraoperative visualization

The latest generation of endoscopes have a large (4.1 mm) working channel

Full-endoscopic surgery has now won a firm place in the surgery of lumbar spine conditions. Provided that the indications for its use are observed, it represents a useful and safe addition or alternative to conventional surgery. Full-endoscopic operations can also be performed on the cervical and thoracic spine. Recent technical developments and the use of new access routes have led to a change that suggests the onset of a revolution in spinal surgery similar to that which occurred in orthopedics with the introduction of arthroscopic procedures. Nevertheless, conventional and maximally invasive operations will continue to play an indispensable role in spinal surgery. Surgeons will need to be able to perform these techniques too in order to overcome problems and complications of full-endoscopic operations such as can occur with any invasive procedure.

The development of new instruments broadens the range of possible procedures

The development of full-endoscopic techniques should not be seen as spelling the end of existing operative standards; rather, it should be seen as a valuable additional option within the field of spinal surgery.

Herne, July 2007

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VERTEBRIS lumbar

The full-endoscopic **trans- and extraforaminal** technique

Percutaneous operations aimed at achieving intradiscal decompression of lumbar intervertebral discs were first described in the early 1970s. Optical systems designed for inspecting the intervertebral space after open operation were introduced in the early 1980s. Later, a full-endoscopic technique using a transforaminal approach was developed. In anatomic terms, this means that the intervertebral disc is reached via a posterolateral approach through the intervertebral foramen between the exiting and traversing nerve roots without need for resection of bony or ligamentous structures. The skin entry point for operative access is determined in centimeters from the midline. Most such operations are performed for the purpose of intradiscal or extradiscal foraminal therapy. Reduction of intradiscal volume and pressure can reduce disc-related compression. Removal of intra and extraforaminal disc material is technically possible. Sequestered material lying within the spinal canal can generally be resected in retrograde fashion intradiscally via the annular defect. This is done using an "in-out" technique.

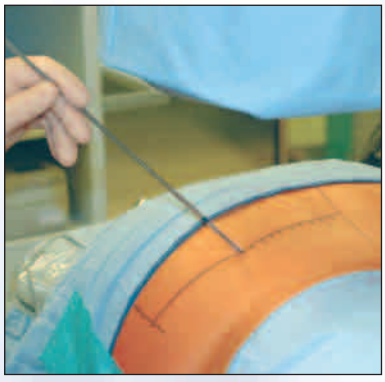
Sequestered nuclear material is found within the spinal canal dorsal to the annulus in the ventral epidural space medial to the medial pedicular line. In many cases it extends to the midline or even to the contralateral side. Clinical experience has shown that the annular defect is often smaller than the diameter of the sequestered material. In addition, there is generally no longer any direct connection to the intradiscal space. In the case of badly degenerated discs or older disc herniations, the continuity of the sequestered material has often been lost and removal in one piece is generally not possible. These factors often make it difficult to resect sequestered nuclear material using an intradiscal retrograde approach. In order to achieve adequate decompression, it is therefore necessary to access the extradiscal ventral epidural space directly under continuous visual control.

The most frequent site of lumbar intervertebral disc herniations is in the lower segments. The diameter of the intervertebral foramen decreases in a cranial to caudal direction. Additional narrowing may result from degenerative changes. Particularly at the lower lumbar levels, these anatomic factors often make it difficult to gain extradiscal access to the ventral epidural space under visual control when using the posterolateral approach. Similarly, lateral placement of the endoscope in order to reach the spinal canal tangentially after access has been created is technically difficult due to the preceding passage through soft tissue and the zygapophyseal joint. These problems make it difficult to achieve adequate decompression on a reliable basis when using the posterolateral approach.

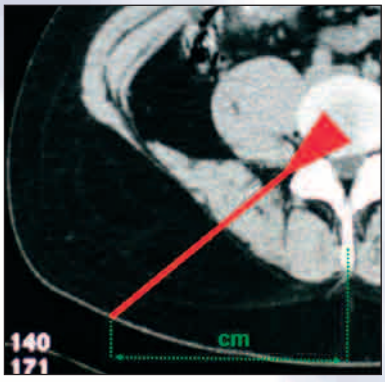
For these reasons a lateral transforaminal approach has been developed in recent years.*

In this technique the skin entry point is determined not by measurement in centimeters, but on an individual anatomic basis under radiographic control. The approach permits tangential access to the spinal canal and consequently the direct visualization of the ventral epidural space with continuous irrigation that is required in order to achieve adequate decompression. Used in combination with newly developed endoscopes with a large working channel and corresponding new instruments, shavers, and burrs, this technique has a broad but clearly defined range of indications.

As a guideline for decompression of the spinal canal, caudal and cranial mobility should extend to the middle and start of the pedicle, respectively. Narrowed foramina are no longer a limitation, since they can be broadened. The pelvis can prevent the required lateral access, therefore in an orthograde lateral radiographic view it should not



The skin entry point for the well-known posterolateral approach is measured in centimeters from the midline



With the posterolateral approach the working area is mostly intradiscal

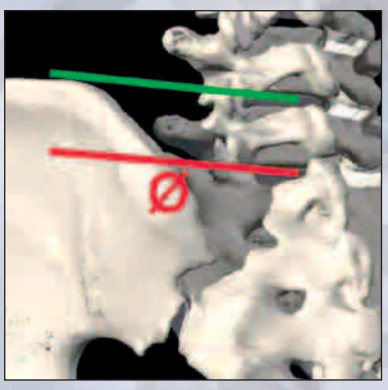
project beyond the middle of the cranial pedicle. At the highest lumbar levels the laterality of the approach is limited by the thoracic and abdominal organs. Because of the greater size of the intervertebral foramen cranially and the possibility of bone resection, a larger radius of action is achieved here and consequently a less lateral access route can be chosen. In the case of intra and extraforaminal decompression operations there are no restrictions. Here, too, a lateral approach is attempted in order to permit atraumatic passage below the exiting spinal root. The surgical access technique for intra- or extraforaminal disc herniations and foraminal stenosis may differ from the conventional technique in order to avoid damaging exiting nerve roots that are dislocated or not definitely localizable. In such cases the extraforaminal approach is used.

Intradiscal procedures such as those required for fusion or infection often call for the posterolateral approach. The approach is always determined by the target point, account being taken of individual pathology and anatomy. Outside of the established indications for its use, the transforaminal approach has definite limitations.

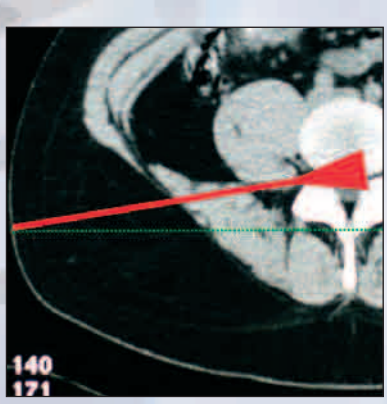
** Ruetten et al. (2005) An extreme lateral access for the surgery of lumbar disc herniations inside the spinal canal using the full-endoscopic uniportal transforaminal approach. – Technique and prospective results of 463 patients. Spine 30:2570–2578*

Ruetten et al. (2007) Use of newly developed instruments and endoscopes: full-endoscopic resection of lumbar disc herniations via the interlaminar and lateral transforaminal approach. J Neurosurg Spine 6:521-530

The lateral transforaminal approach provides access to the spinal canal in the lower lumbar segments



In the lower lumbar segments the pelvis can prevent the required lateral transforaminal access



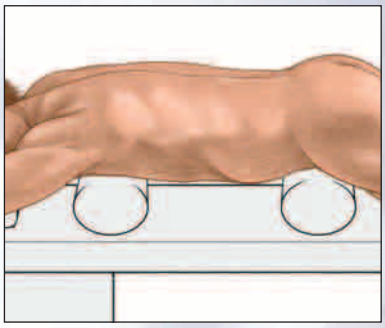
The lateral transforaminal approach shifts the working area to the spinal canal

VERTEBRIS lumbar

The full-endoscopic **trans- and extraforaminal** technique

1. Positioning of the patient

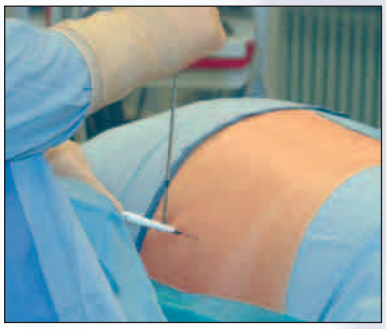
The patient is positioned prone on a radiolucent table with a pelvic and a thoracic roll. Use of a C-arm is required during the operation.

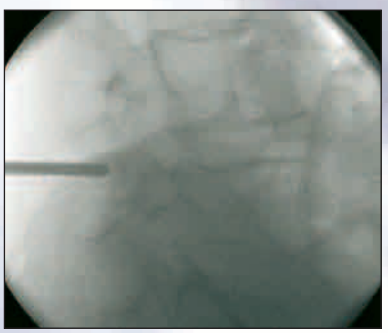


Prone position with pelvic and thoracic roll

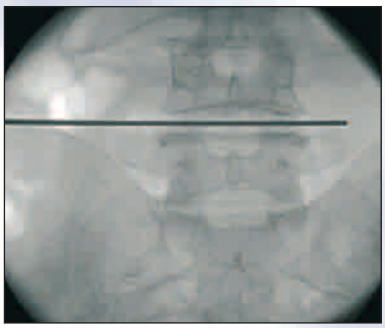
2. Determination of lateral access route

Access is determined on the basis of anatomic landmarks under orthograde lateral and posteroanterior fluoroscopic guidance, account being taken of the pathology. Depending on the level, the possibility of injury to abdominal organs must be excluded.





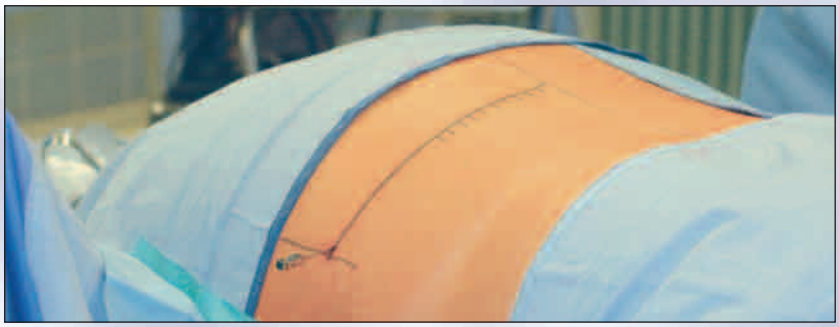
Determination of maximum ventrality on the basis of individual anatomic landmarks and marking of the entry line on the skin



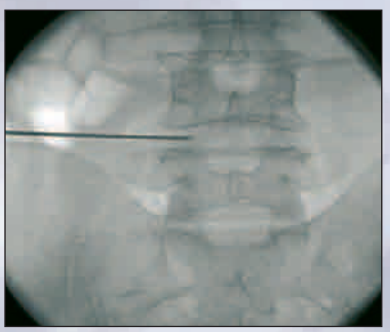
Determination of the intervertebral disc level under orthograde posteroanterior fluoroscopic guidance and determination of the skin entry point

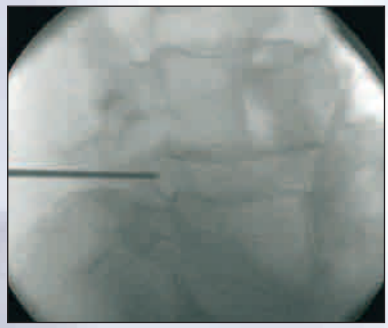
3. Creation of lateral access

After the skin entry point has been determined and the puncture incision made, a spinal cannula is introduced under fluoroscopic guidance, care being taken not to damage neural structures. Positioning in relation to the spinal canal is determined individually in accordance with the target point. The guidewire is then introduced and the spinal cannula removed.

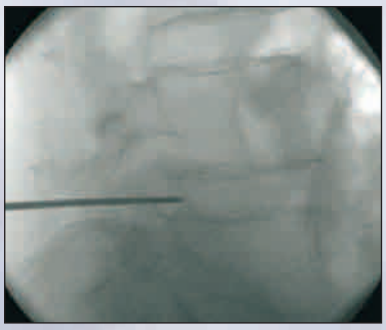


Introduced spinal cannula





The spinal cannula touches the dorsal annulus at the medial pedicular line at the beginning of the spinal canal



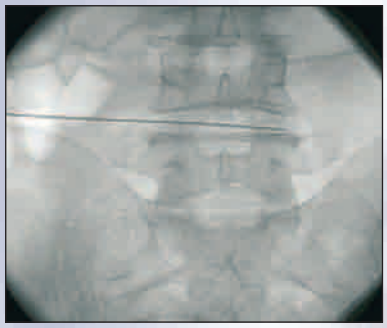
The spinal cannula is advanced in the dorsal annulus towards the spinal canal

VERTEBRIS lumbar

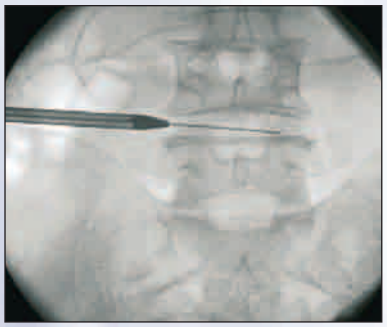
The full-endoscopic **trans- and extraforaminal** technique

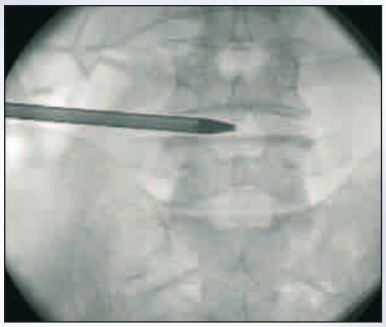
Using rotatory movements, the dilator is passed along the guidewire as far as the foramen. After removal of the guidewire it is – depending on the pathology – inserted into the spinal canal.

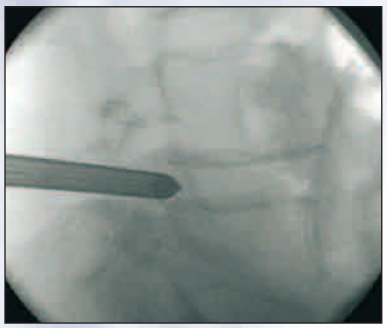
A beveled working sleeve is then inserted over the dilator and the dilator is removed. Care must be taken to protect neural structures during all working steps.



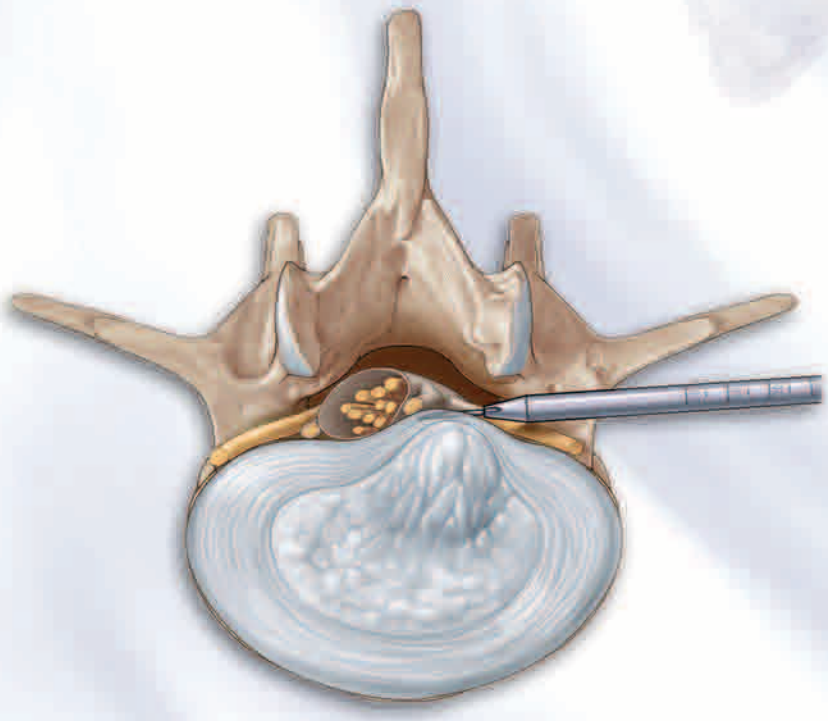
The guidewire is positioned and the spinal cannula is removed

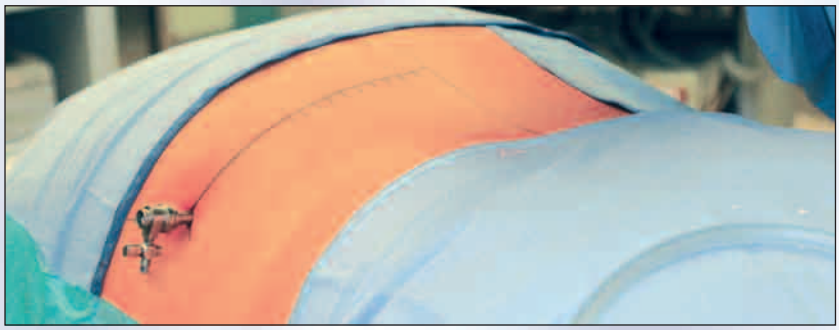


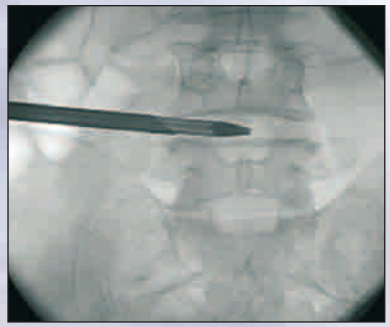


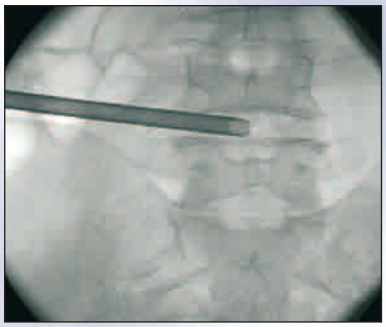


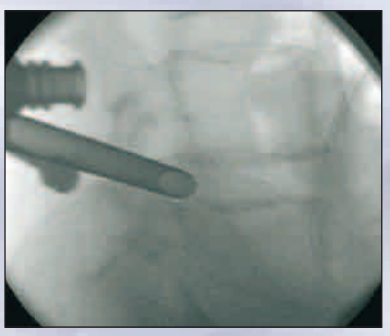
The dilator is inserted over the guidewire and is in the final position in the spinal canal or dorsal annular defect



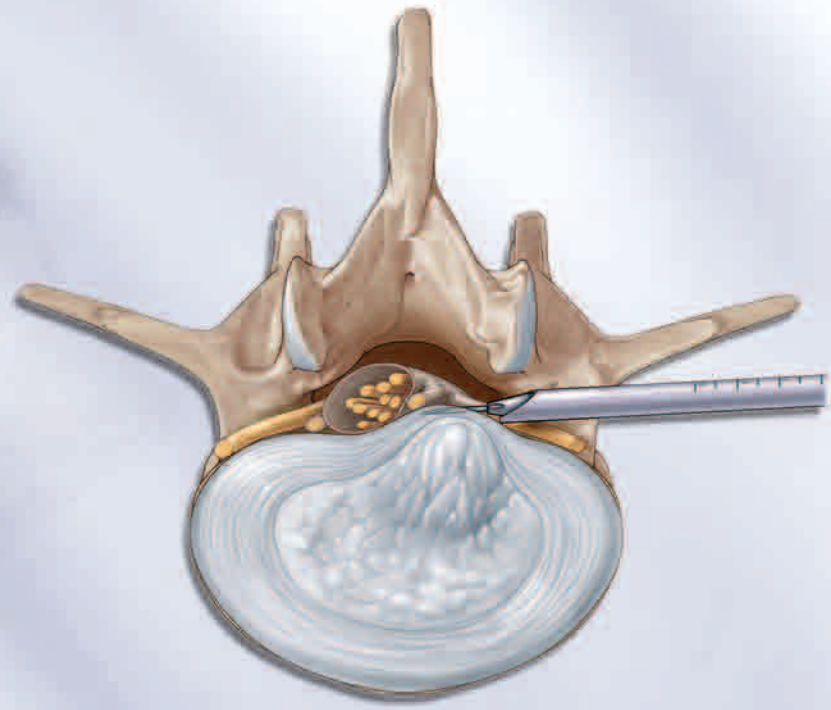








The working sleeve is positioned via the dilator and the dilator is removed. The beveled opening is situated inside the spinal canal dorsal to the annulus



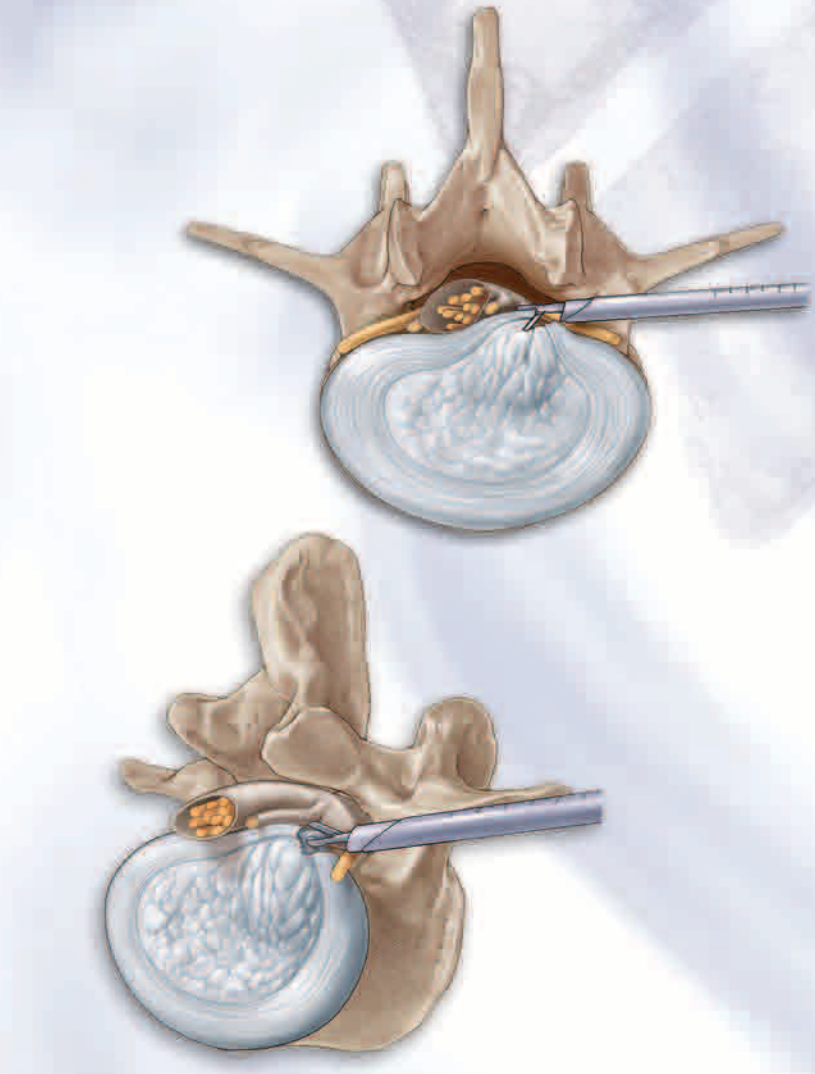
VERTEBRIS lumbar

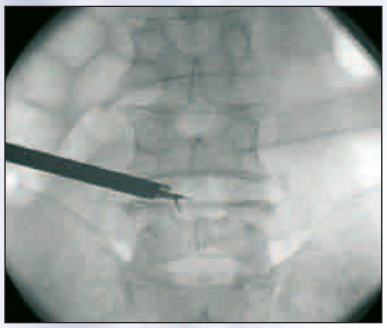
The full-endoscopic **trans- and extraforaminal** technique

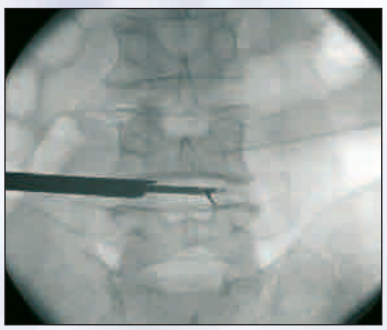
4. Performance of operation

The endoscope is passed through the working sleeve. The operation is performed via the intraendoscopic working channel using alternating sets of instruments under full visual control and with continuous irrigation.

The sealing caps for the optic und working sleeve should be used only for brief periods when bleeding obscures vision, since with long operation times and unnoticed obstruction to backflow of irrigation fluid there is a theoretical risk of volume overload and increased pressure within the spinal canal and in the associated and adjacent structures. Experience has shown that, as with all new techniques, the risk of complications is greatest during the learning period.



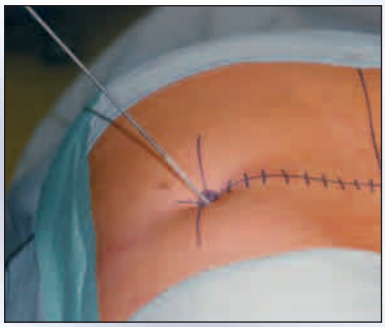




The lateral approach makes it possible to work in the spinal canal under full visual control

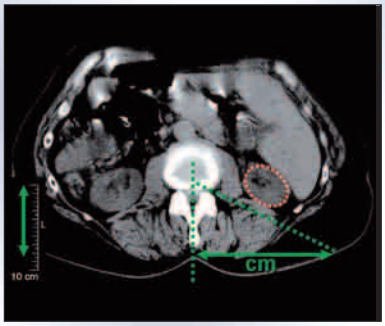
5. Creation of posterolateral access

Obstruction of lateral access by the pelvis or the risk of causing injury to abdominal or thoracic organs in the cranial lumbar segments can necessitate a more posterior or even a posterolateral approach in intradiscal operations. The skin entry point depends on the individual pathology and anatomy and can be either measured in centimeters from the midline or determined by appropriate positioning of the introduced spinal cannula. The subsequent steps, including insertion of the guidewire, the dilator, the sheath, and finally the optic, are the same as in the procedure described above.

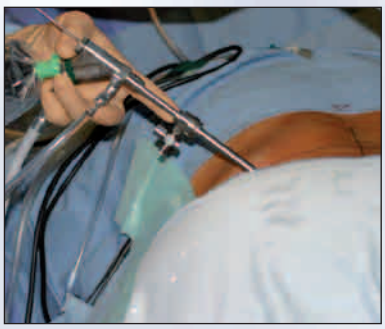


Measurement of the skin entry point in centimeters from the midline

The introduced spinal cannula at the desired target point can determine the site of the puncture incision



The maximum laterality of access can be determined on the basis of a preoperative CT scan so as to prevent injury to organs



Operation with posterolateral transforaminal approach

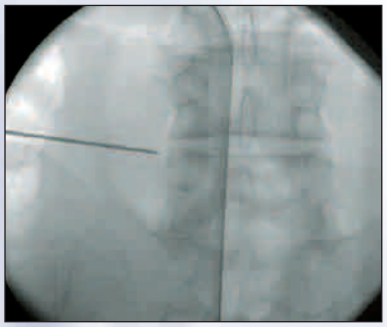
VERTEBRIS lumbar

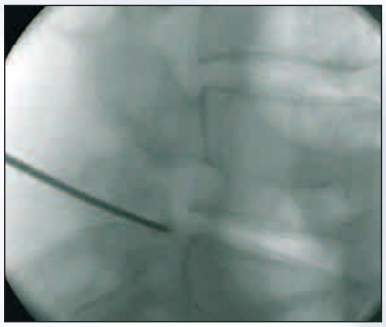
The full-endoscopic **trans- and extraforaminal** technique

6. Creation of extraforaminal access

In intra- and extraforaminal intervertebral disk herniations and in foraminal stenosis, the exiting nerve roots may be at increased risk of injury when the access instruments are passed through the foramen. This may necessitate an extraforaminal approach. The skin entry point can be posterolateral to lateral. Instead of being inserted through the foramen into the spinal canal, the spinal cannula is advanced onto the caudal pedicle of the segment to be operated on. This is the safest area in terms of the exiting nerve roots and its use reduces the risk of access-related injury. Subsequently the guidewire, the dilator, and the sheath are likewise advanced until they make bony contact with the pedicle. The anatomic structures of the caudal foramen are then dissected under direct vision, the exiting nerve root is identified, and the operation is performed without damaging the nerve root.

The caudal pedicle is a safe area in terms of the exiting spinal nerve root



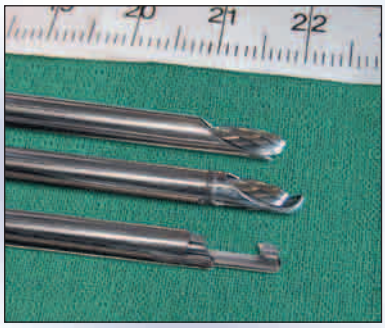


Insertion of the spinal cannula as far as the caudal pedicle

Dissection of the anatomic structures of the caudal foramen and the exiting spinal nerve root

7. Bone resection

Resection of bone may be required in order to increase mobility within the spinal canal or when problems arise during access. This can occur, for example, in cases of degenerative or hereditary foraminal stenosis and in recess stenosis operations. The skin entry point can be posterolateral to lateral. After trans- or extraforaminal access has been obtained the bony structures must be dissected for this purpose. In most cases ventral parts of the ascending facet are resected. When parts of the caudal pedicle are resected it must be remembered that this is a weightbearing structure. Extensive resection can weaken the biomechanical structure and result in pedicle fractures.



A range of burrs and bone punches are available for bone resection

Sometimes damaging of the joint in order to reach the medial edge of the ascending facet can not be avoided

In most cases ventral parts of the ascending facet are resected

VERTEBRIS lumbar

The full-endoscopic **trans- and extraforaminal** technique

8. Biportal access

A biportal approach can be required in certain indications such as spondylodiscitis and insertion of implants and when working with special instruments. Access is normally posterolateral using the standard technique. The endoscope can be inserted either unilaterally or in alternating fashion.

Biportal transforaminal access

VERTEBRIS lumbar

The full-endoscopic **interlaminar** technique

Full-endoscopic interlaminar access

Direct access to the epidural space under continuous vision is a precondition for the performance of satisfactory operations within the spinal canal. When the full-endoscopic transforaminal technique is used, the lateral approach is often required for this purpose. The bony and neural boundaries of the neuroforamen impose limits to mobility and thus also to the indications for operations of this type. Moreover, in the lower lumbar segments the required lateral access can be blocked by the pelvis. It has been found that these limitations make it technically impossible to operate on some pathologies using the full-endoscopic transforaminal approach.

In order to reduce the incidence of surgically induced traumatization of the structures of the spinal canal, it is expedient to make use of anatomically preformed access routes. In addition to the intervertebral foramen, these include the sacral hiatus and the interlaminar window. For technical reasons, epiduroscopy via the sacral hiatus does not permit resection of large structures. This leaves open the possibility of surgical access via the interlaminar window, a long-established and commonly used technique in lumbar spine surgery that was first described in the early 1920s. Various alternative methods were developed in later years, e.g. posterolateral biopsy of the spine in the late 1940s and intradiscal decompression by means of chemonucleolysis in the early 1970s. Endoscopic inspection of the intervertebral space after open decompression was described in the early 1980s. Full-endoscopic operations were performed mostly using the transforaminal technique with posterolateral access.

A microsurgical technique performed with the aid of a microscope was developed in the late 1970s and went on to become the gold standard for interlaminar decompression of the spinal canal. An endoscopically guided technique, or microendoscopic operation, was described in the late 1990s. This used an endoscope to provide visualization of the exposed surgical site on a monitor.

Use of the endoscope based on the joystick principle provides mobility

With the conventional technique, the spinal canal has to be opened in order to gain access to the epidural space. This generally involves not only incision of the ligamentum flavum, but also resection of bone. The basic requirement is to achieve adequate access that provides visualization of the spinal canal and permits work with instruments. Problems can arise as a result of traumatization of the access pathway, resection of stabilizing structures, and – especially in relation to the possible need for revision operations – scarring. The basic role of the microscope is to reduce the size of the access route and provide optimal conditions of light and vision. Resection of structures of the spinal canal is generally unavoidable. The microendoscopic technique provides access with less trauma than does the microscopic technique. Its advantage lies in the smaller distance between the working area and the visualizing system. Visual conditions and illumination are generally worse. It is not a full-endoscopic technique in the strict sense. Nowadays microendoscopic access is sometimes combined with a microscopic surgical technique. Common to all of these techniques is the fact that the access pathway generally has to be bigger than would be necessary for the actual work to be performed in the spinal canal.

The full-endoscopic interlaminar approach was therefore developed in recent years in order to exploit the known advantages of transforaminal operations and arthroscopy.*

* *Ruetten et al. (2006) A new full-endoscopic technique for the interlaminar operation of lumbar disc herniations using 6 mm endoscopes: Prospective 2-year results of 331 patients. Minim Invasive Neurosurgery 49:80-87*

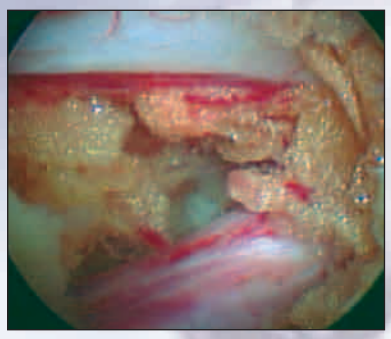
Ruetten et al. (2007) Use of newly developed instruments and endoscopes: full-endoscopic resection of lumbar disc herniations via the interlaminar and lateral transforaminal approach. J Neurosurg Spine 6:521-530

VERTEBRIS lumbar

The full-endoscopic **interlaminar** technique

The fact that the lighting and imaging system with its 25° angle of vision is situated right in the working area makes it possible to minimize traumatization not only of the access pathway, but also of structures of the spinal canal. Continuous irrigation provides excellent visual conditions. Mobility is achieved by handling of the new endoscope using the joystick technique. Neural structures are protected by use of the beveled operating sheath as a nerve hook. When used in conjunction with the newly developed instruments, this is a genuinely minimally invasive technique.

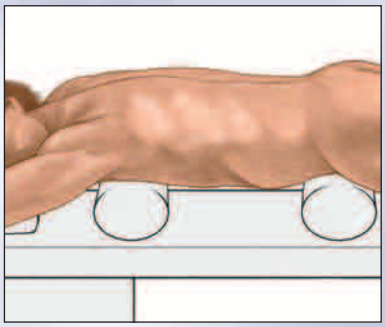
The main indications are pathologies situated within the spinal canal. Attention must be paid to the width of the interlaminar window, which if too narrow may prevent free passage of the endoscope. If this occurs the bone can be resected with a burr until the target point is reached without opening the ligamentum flavum or damaging the zygapophyseal joints. Bone resection should generally be avoided, though in cases of spinal canal stenosis it may be necessitated by the pathology. The incision in the ligamentum flavum can be limited to a few millimeters, since penetration into the spinal canal is facilitated by the elasticity of the ligament. Mobility to the contralateral side is similar to that with conventional operations. In order to minimize resection of structures of the spinal canal, craniocaudal access via neighboring lumbar segments may be considered. The full-endoscopic interlaminar technique permits selective surgery on pathologies situated within the spinal canal with minimal access-induced traumatization. The transforaminal technique is generally more suitable for intradiscal and intra- or extraforaminal work. The transforaminal approach is subject to more limitations than the interlaminar approach, but causes less tissue damage. Due to anatomic and pathologic factors, the ratio of transforaminal to interlaminar procedures in clinical practice is about 40 to 60.



The interlaminar approach provides outstanding visualization of the structures of the spinal canal

1. Positioning

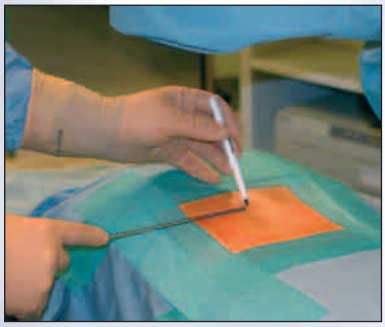
The patient is positioned prone on a radiolucent table with a pelvic and a thoracic roll. Use of a C-arm is required during the operation.



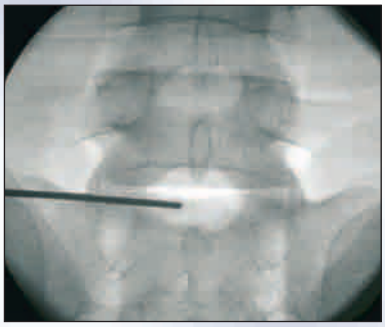
Prone position with pelvic and thoracic roll

2. Determination of access route

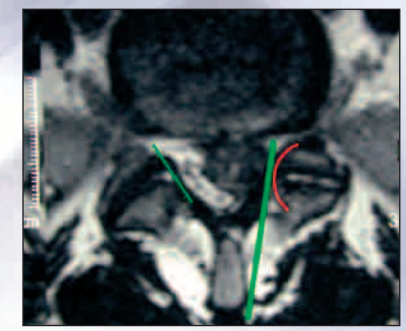
Access is determined on the basis of anatomic landmarks under posteroanterior fluoroscopic guidance, account being taken of the pathology. The skin incision should be made as far medially in the interlaminar window as possible in order to permit insertion in a lateral direction below the obliquely oriented zygapophyseal joints.



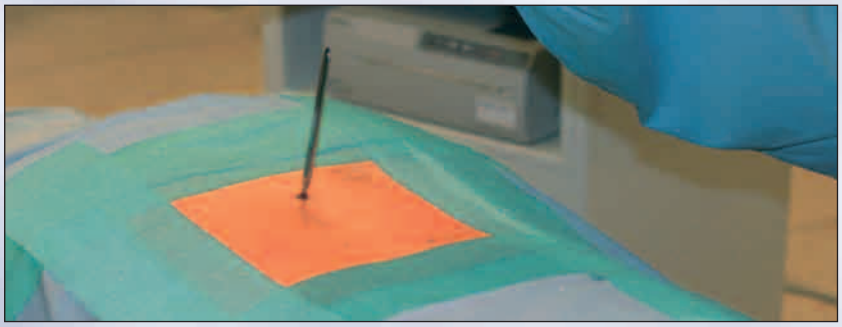
Marking of skin entry point



The skin entry point should be as medial as possible



Entry below the zygapophyseal joints should be made possible



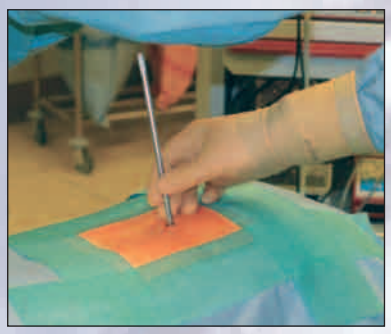
Puncture incision

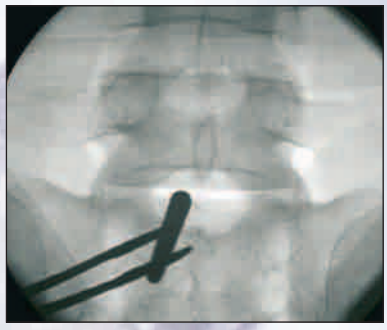
VERTEBRIS lumbal

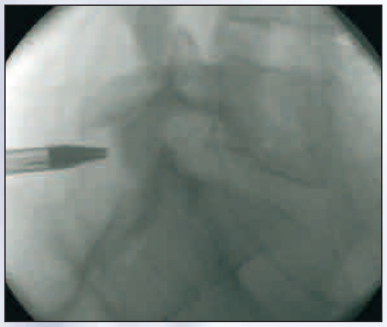
The full-endoscopic **interlaminar** technique

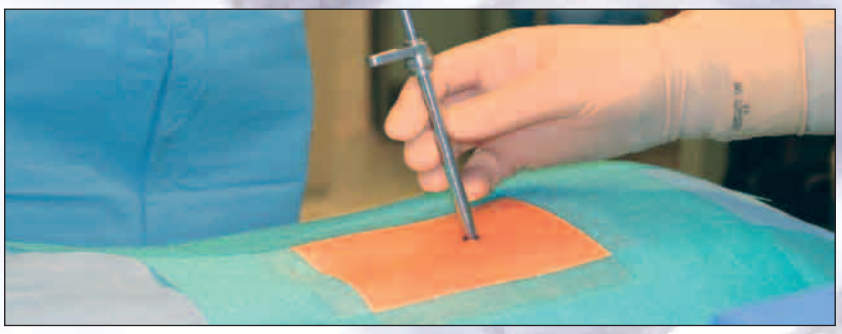
3. Creation of access

After the skin entry point has been determined and the puncture incision made, the dilator is inserted as far as the ligamentum flavum under postero-anterior fluoroscopic guidance. The subsequent procedure is performed under lateral fluoroscopic guidance. The working sleeve with a beveled opening is advanced towards the ligament via the dilator and the dilator is removed.

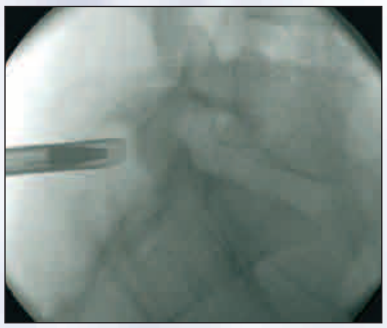


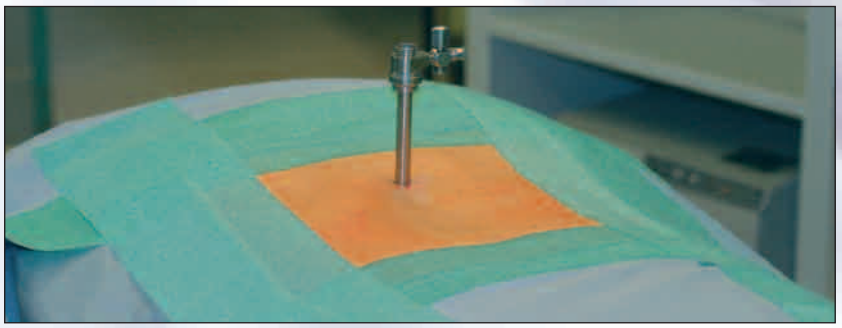






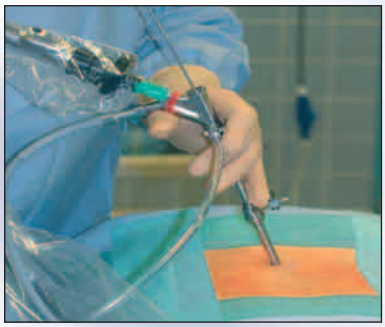
Insertion firstly of the dilator and then of the sheath to the ligamentum flavum under fluoroscopic guidance



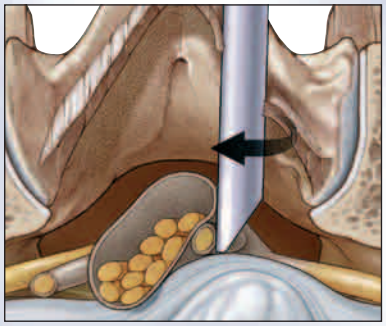


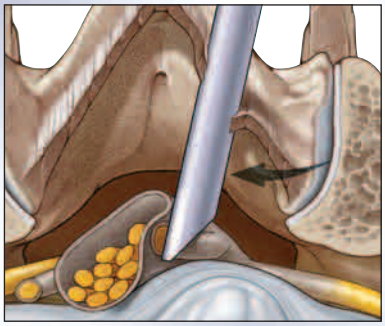
4. Performance of operation

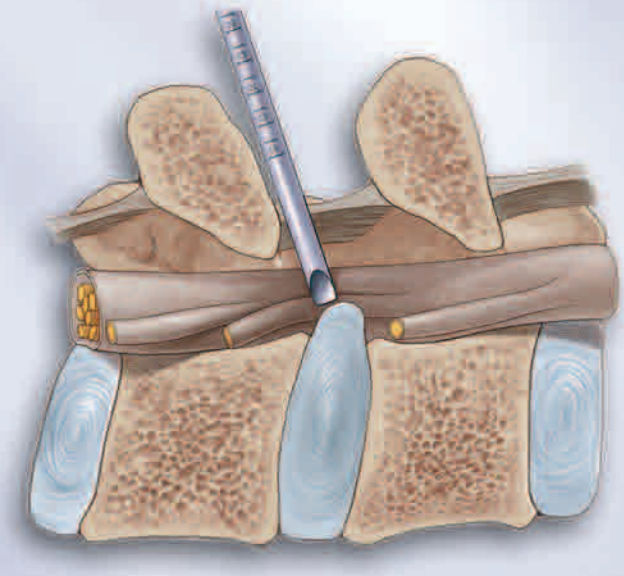
The endoscope is passed through the working sleeve. The operation is per formed via the intraendoscopic working channel using alternating sets of instruments under full visual control and with continuous irrigation. Once the ligamentum flavum has been opened, the spinal canal can be entered. Mobility is achieved by handling the endoscope using the joystick technique. The operating sheath with its beveled opening serves as a second instrument and can be rotated so as to protect the neural structures.



The operating sheath with its beveled opening can be rotated so as to serve as a second instrument



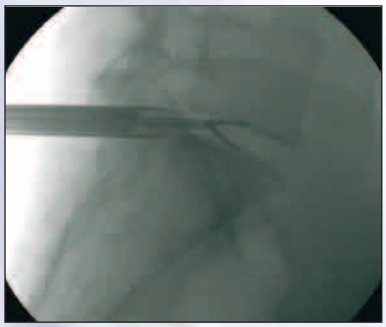


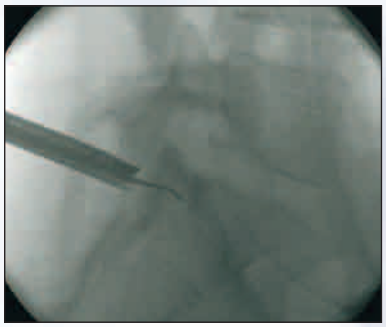


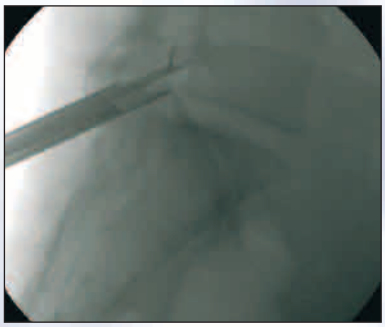
VERTEBRIS lumbal

The full-endoscopic **interlaminar** technique

The sealing caps for the optic und working sleeve should be used only for brief periods when bleeding obscures vision, since with long operation times and unnoticed obstruction to backflow of irrigation fluid there is a theoretical risk of volume overload and increased pressure within the spinal canal and in the associated and adjacent structures. In order to reduce the risk of neurologic damage particularly in the cranial segments, prolonged and continuous excessive medial retraction of the neural structures with the working sleeve must be avoided or else retraction must be performed on an intermittent basis. Experience has shown that, as with all new techniques, the risk of complications is greatest during the learning period.

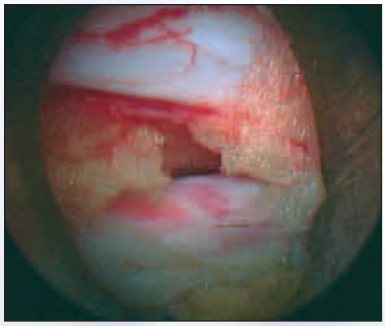






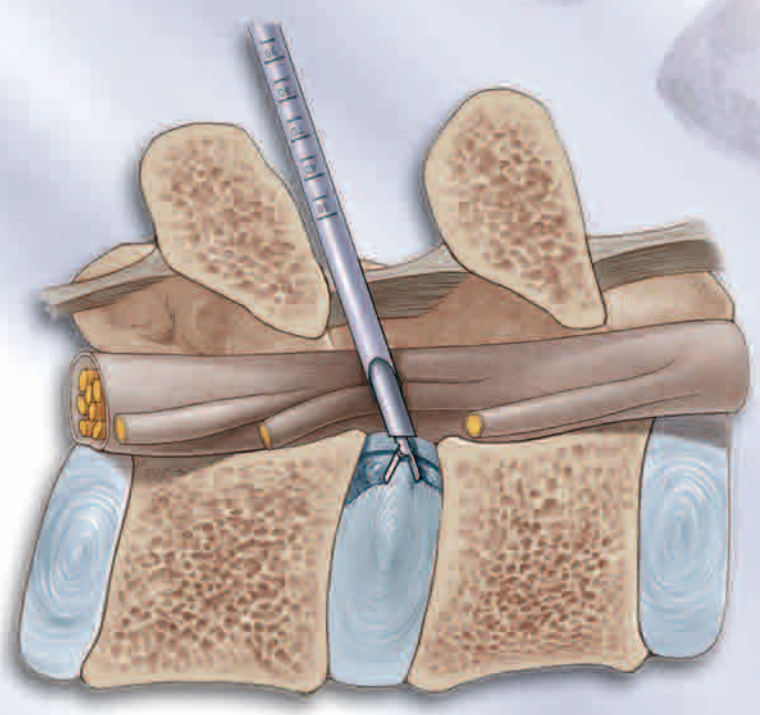
Use of the endoscope based on the joystick principle provides mobility

Opening of the ligamentum flavum



View of L5-S1 axilla

Bone can be resected as necessary using the available instruments and burrs



The interlaminar approach makes it possible to work in the spinal canal under visual control

VERTEBRIS lumbal

The full-endoscopic **interlaminar** technique

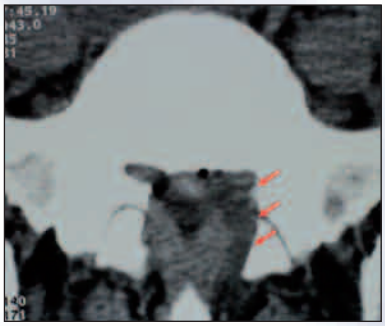
5. Bone resection

Resection of bone may be required in order to increase mobility within the spinal canal or when problems arise during access. This can occur, for example, in cases of sequestered disc herniations or small interlaminar window and in recess stenosis operations. After access has been obtained, the bony structures are dissected. It may be useful to start decompression at the caudal end of the descending facet. Depending on the pathology, medial parts of the descending or ascending facet or of the caudal and cranial lamina are then resected.

It may be useful to start decompression at the caudal end of the descending facet

A range of burrs and bone punches that can be introduced through the intraendoscopic working channel are available for bone resection

The extent of bone resection depends on the pathology



Lateral bone resection is performed on the floor of the spinal canal in the working area

VERTEBRIS thoracic

Introduction

Depending on the individual pathology and anatomy, transforaminal and interlaminar procedures can also be performed in the thoracic spine. The principal indication is thoracic intervertebral disc herniations without major spinal cord compression that remains symptomatic despite conservative therapy. Only laterally situated pathologies are generally amenable to operation, since manipulation of the spinal cord must be avoided because of the risk of injury and because lateral transforaminal access is prevented by the thoracic organs. When a transforaminal procedure is planned, a preoperative CT scan should always be performed in order to determine the exact skin entry point and the possibility of free access to the intervertebral disc. Interlaminar access normally requires resection of bone, since the size of the interlaminar window is generally insufficient, especially lateral to the spinal cord. Operations using either access route can be performed anywhere from the cervicothoracic to the thoracolumbar junction and are performed in the same way as in the lumbar spine.

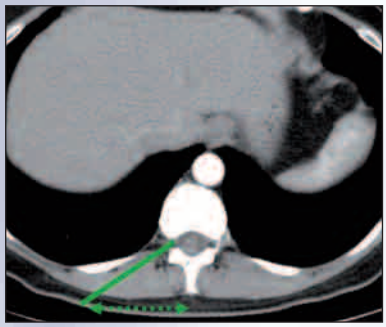
Thoracic disc herniation

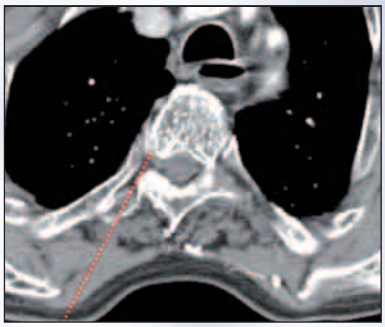
Compared to the lumbar spine, the thoracic spine is subject to a greater risk of injury to neural and surrounding structures and hence also to technical limitations in terms of access and surgical procedure. In cases that are borderline in terms of anatomy, pathology, or clinical features, a conventional operation may be the only suitable option.

VERTEBRIS thoracic

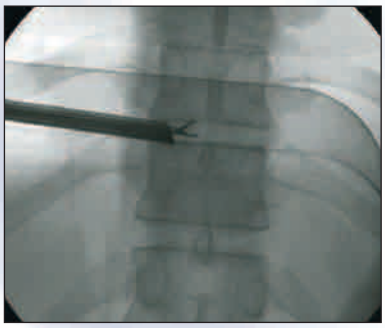
1. The full-endoscopic transforaminal technique

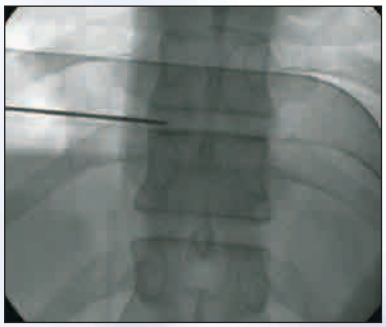
Access is determined with the aid of a preoperative CT scan. Structures to be spared are laterally the lung, medially the spinal cord, and ventrally the vessels. Access may be prevented by anatomic or degenerative bone structures such as ribs, transverse processes, or osteophytes. In general a decidedly posterior approach is required.

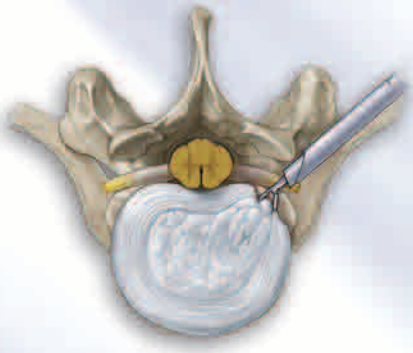




In order not to cause injury, the spinal cannula should be inserted parallel to the intervertebral space under postero-anterior fluoroscopic guidance; it should lie strictly caudally in the foramen and on making contact with the disc should be situated exactly between the medial and the lateral pedicular line in the foramen. For added safety the spinal cannula can first be advanced onto the bony structures of the intervertebral joint and then directed ventrally along the bone. After the dilator, the operating sleeve, and the optic have been introduced, particular attention should be paid during the operation to the medially situated spinal cord.

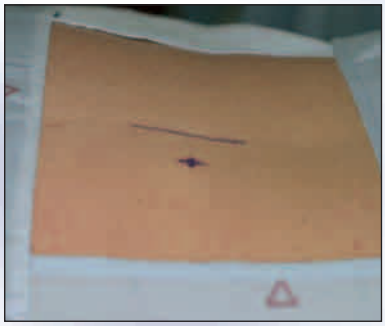


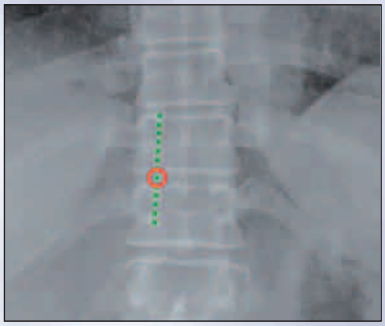


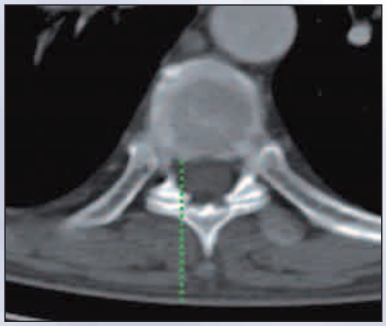


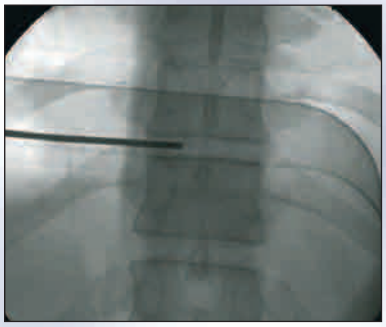
2. The full-endoscopic interlaminar technique

The skin entry point is situated over the intervertebral joint/disc on the medial pedicular line, as in cervical foraminotomy. From this point the spinal canal can be reached without manipulation of the spinal cord.

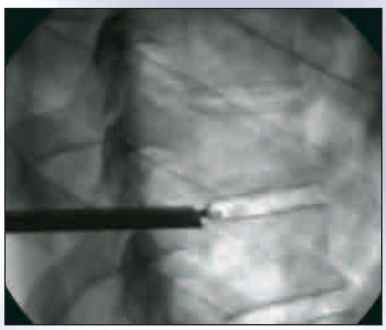


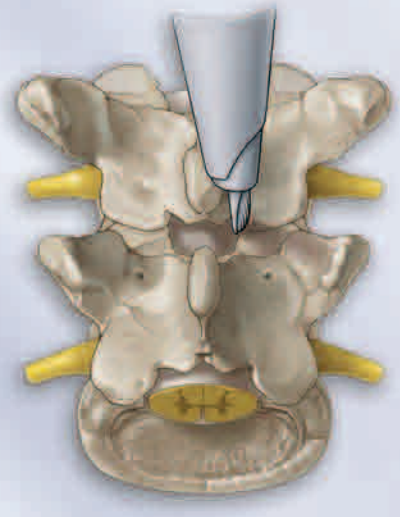


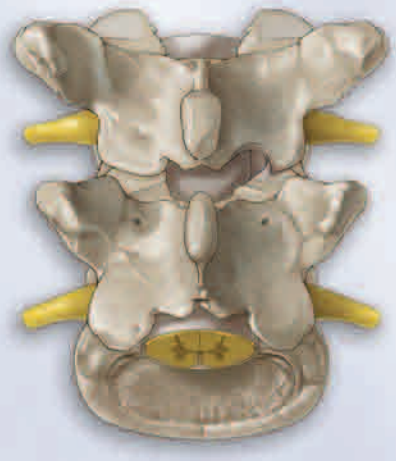




After the dilator, the operating sleeve, and the optic have been introduced, the size of the interlaminar window is generally found to be insufficient to permit entry into the spinal canal without bone resection. A small amount of burring is therefore performed on the medial side of the joint facets and if necessary on the cranial and the caudal laminae. The lateral part of the spinal canal must be accessible as far as the intervertebral disc without need to displace the spinal cord medially. There is no limit to craniocaudal extension.







VERTEBRIS

Basic set, ***VERTEBRIS* lumbar trans-, extraforaminal** Set-Nr. 892101111

Article	Types	pcs.
PANOVIEW Plus discoscope, 25°, WL 207 mm, Ø 6.9 x 5.6 mm, working channel Ø 4.1 mm	**89210.1254**	**1**
Conical adapter	**8791.751**	**1**
Membrane attachment	**8792.451**	**1**
Spinal cannula set, 10 pieces, sterile, WL 150 mm, Ø 1.25 mm	**4792.803**	**1**
Dilator, Ø. 6.9 mm	**89220.1508**	**1**
Working sleeve with bevel, Ø 8.0 mm, WL 185 mm	**89220.1078**	**1**
Irrigation adapter, Ø 8.0 mm	**89220.1308**	**1**
Extension sleeve, Ø 8.0 mm	**89220.1408**	**1**
Micro-punch, Ø 2.5 mm, curved, WL 360 mm, (fits in 4 mm working channel)	**89240.1034**	**1**
Micro-punch, Ø 2.5 mm, WL 360 mm	**8792.671**	**1**
Micro-rongeur with long jaws, Ø 2.5 mm, WL 360 mm	**89240.1125**	**1**
Micro-rongeur, Ø 2.5 mm, curved, WL 360 mm, (fits in 4 mm working channel)	**89240.1044**	**1**
Nucleus grasping forceps, Ø 3.0 mm, WL 360 mm	**89230.1003**	**1**
Nucleus grasping forceps, Ø 4.0 mm, WL 360 mm	**89230.1004**	**1**
Tube shaft punch, Ø 4.0 mm, WL 360 mm	**89240.1904**	**1**
Atraumatic dissector, Ø 2.5 mm, WL 350 mm	**8792.591**	**1**
Atraumatic dissector, Ø 4.0 mm, WL 350 mm	**89250.1004**	**1**
X-Tractor	**89230.0000**	**1**
Mallet	**8866.956**	**1**
"Surgitron" radiofrequency unit	**2343.001/ .002**	**1**
Trigger Flex handpiece, complete	**8792.691**	**1**
Trigger Flex bipolar electrodes	**4792.6912**	**1**

Basic set, ***VERTEBRIS* lumbar and thoracic interlaminar** Set-Nr. 892102222

Article	Types	pcs.
PANOVIEW Plus discoscope, 25°, WL 165 mm, Ø 6.9 x 5.6 mm, working channel Ø 4.1 mm	**89210.3254**	1
Conical adapter	**8791.751**	1
Membrane attachment	**8792.451**	1
Dilator, Ø 6.9 mm	**89220.1508**	1
Working sleeve with bevel, Ø 8.0 mm, WL 120 mm	**89220.3008**	1
Irrigation adapter, Ø 8.0 mm	**89220.1308**	1
Micro-punch, Ø 2.5 mm, WL 290 mm	**89240.2225**	1
Micro-punch, Ø 2.5 mm, curved, WL 360 mm	**89240.1034**	1
Micro-rongeur, Ø 2.5 mm, WL 290 mm	**89240.2025**	1
Rongeur, Ø 3.0 mm, WL 290 mm	**89240.3003**	1
Rongeur, Ø 4.0 mm, WL 290 mm	**89240.3004**	1
Tube shaft punch, Ø 4.0 mm, WL 290 mm	**89240.3904**	1
Atraumatic dissector, Ø 2.5 mm, WL 350 mm	**8792.591**	1
Atraumatic dissector, Ø 4.0 mm, WL 350 mm	**89250.1004**	1
"Surgitron" radiofrequency unit	**2343.001/ .002**	1
Trigger Flex handpiece, complete	**8792.691**	1
Trigger Flex bipolar electrodes	**4792.6912**	1

VERTEBRIS COMBIDRIVE burr and shaver set Set-Nr. 892104444

Article	Types	pcs.
COMBIDRIVE EN set	**20951.0000**	1
Angled handpiece	**82950.1301**	1
Ball burr, Ø 3.0 mm, WL 350 mm, pack of 3	**82960.3730**	1
also: Outer tube, distally hooded, Ø 4.0 mm	**82970.1330**	1
Ball burr diamond, Ø 3.0 mm, WL 350 mm, pack of 3	**82960.3930**	1
also: Outer tube, distally hooded, Ø 4.0 mm	**82970.1330**	1
Ball burr diamond, Ø 4.0 mm, WL 350 mm, pack of 3	**82960.3940**	1
also: Outer tube, open, Ø 4.0 mm	**82970.1340**	1
POWER STICK M 5/0	**89955.0000**	1
Connecting cable, 3 m long	**8564.851**	1
Nucleus resectorr, Ø 4.0 mm, laterally hooded, WL 350 mm	**89975.1004**	1
Ball burr, Ø 4.0 mm, WL 350 mm	**89975.1304**	1
Oval burr, Ø 4.0 mm, laterally hooded, WL 350 mm	**89975.1504**	1
Oval burr, Ø 4.0 mm, laterally and distally hooded, WL 350 mm	**89975.1514**	1

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Basic set, ***VERTEBRIS* universal** Set-Nr. 892103333

Article	Types	pcs.
PANOVIEW Plus discoscope, 25°, WL 165 mm, Ø 6.9 x 5.6 mm, working channel Ø 4.1 mm	**89210.3254**	**1**
Working sleeve with bevel, Ø 8.0 mm, WL 120 mm	**89220.3008**	**1**
PANOVIEW Plus discoscope, 25°, WL 207 mm, Ø 6.9 x 5.6 mm, working channel Ø 4.1 mm	**89210.1254**	**1**
Conical adapter	**8791.751**	**1**
Membrane attachment	**8792.451**	**1**
Spinal cannula set, 10 pieces, sterile, WL 150 mm, Ø 1.25 mm	**4792.803**	**1**
Dilator, Ø. 6.9 mm	**89220.1508**	**1**
Working sleeve with bevel, Ø 8.0 mm, WL 185 mm	**89220.1078**	**1**
Irrigation adapter, Ø 8.0 mm	**89220.1308**	**1**
Extension sleeve, Ø 8.0 mm	**89220.1408**	**1**
Micro-punch, Ø 2.5 mm, curved, WL 360 mm, (fits in 4 mm working channel)	**89240.1034**	**1**
Micro-punch, Ø 2.5 mm, WL 360 mm	**8792.671**	**1**
Micro-rongeur with long jaws, Ø 2.5 mm, WL 360 mm	**89240.1125**	**1**
Micro-rongeur, Ø 2.5 mm, curved, WL 360 mm, (fits in 4 mm working channel)	**89240.1044**	**1**
Nucleus grasping forceps, Ø 3.0 mm, WL 360 mm	**89230.1003**	**1**
Nucleus grasping forceps, Ø 4.0 mm, WL 360 mm	**89230.1004**	**1**
Atraumatic dissector, Ø 2.5 mm, WL 350 mm	**8792.591**	**1**
Atraumatic dissector, Ø 4.0 mm, WL 350 mm	**89250.1004**	**1**
X-Tractor	**89230.0000**	**1**
Mallet	**8866.956**	**1**
"Surgitron" radiofrequency unit	**2343.001/ .002**	**1**
Trigger Flex handpiece, complete	**8792.691**	**1**
Trigger Flex bipolar electrodes	**4792.6912**	**1**

Endoscopes, working channel 2.7 mm

Article		Types
	PANOVIEW Plus discoscope, 20°, Ø 5.8 x 5.1 mm, WL 205 mm	**8792.411**
	PANOVIEW Plus discoscope, 20°, Ø 5.8 x 5.1 mm, MRI-compatible, WL 205 mm	**8767.412**

Endoscopes, working channel 3.1 mm

Article		Types
	PANOVIEW Plus discoscope, 25°, Ø 5.9 x 5.0 mm, WL 207 mm	**89210.1253**
	PANOVIEW Plus discoscope, 25°, Ø 5.9 x 5.0 mm, WL 165 mm	**89210.3253**

Endoscopes, working channel 4.1 mm

Article		Types
	PANOVIEW Plus discoscope, 25°, Ø 6.9 x 5.6 mm, WL 207 mm	**89210.1254**
	PANOVIEW Plus discoscope, 25°, Ø 6.9 x 5.6 mm, WL 165 mm	**89210.3254**

Endoscope accessories/attachments

Article		Types
	Sealing cap attachment, incl. 10 rubber caps	**8792.452**
	Sealing caps Ø up to 2.4 mm, pack of 10	**89.00**
	Sealing membrane	**15 479.006**
	Membrane attachment	**8792.451**
	Tap attachment	**8791.951**
	Conical adapter	**8791.751**
	O-rings for sealing between fluid adaptor and endoscope, pack of 10	**9500.113**
	Plug-on eyepiece funnel for connecting C-mount objectives to endoscope optics with plug-on connection	**8885.901**
	Drip rejector, pack of 20	**89200.1000**
	Preparation basket for mechanical preparation and sterilization for discoscopes 89210.xxxx	**38044.411**
	Preparation basket for mechanical preparation and sterilization for discoscopes 8792.411, 8767.412	**38044.111**
	Antifogging agent	**102.02**
	Cleaning brush	**6.03**

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Spinal cannula set

Article		Types
	Spinal cannula set, Ø 1.25 mm, pack of 10, sterile, WL 250 mm	**4792.802**
	Spinal cannula set, Ø 1.25 mm, pack of 10, sterile, WL 150 mm	**4792.803**
	Spinal cannula set, Ø 1.5 mm, pack of 10, sterile, WL 150 mm	**492201115**
	Spinal cannula set, Ø 1.5 mm, pack of 10, sterile, WL 250 mm	**492201215**

Dilators

Article		Types
	Dilator, Ø 5.9 mm, 1-channel for working sleeves Ø 7.0 mm	**8792.763**
	Dilator, Ø 5.9 mm, 2-channel for working sleeves Ø 7.0 mm	**8792.764**
	Dilator, Ø 6.9 mm, 2-channel for working sleeves Ø 8.0 mm	**89220.1508**

Working sleeves, Ø 7.0 mm

Article		Types
	Working sleeve with 30° bevel, WL 120 mm	**89220.3007**
	Working sleeve for foraminoplasty, WL 145 mm	**89220.1017**
	Working sleeve without window, WL 145 mm	**89220.1057**
	Working sleeves, basic set, WL 165 mm	**89220.1907**
	Working sleeve with long elevator lip, WL 165 mm	**89220.1117**
	Working sleeve with long window, WL 165 mm	**89220.1087**
	Working sleeve for foraminoplasty, WL 165 mm	**89220.1007**
	Working sleeve with distally closed window, WL 165 mm	**89220.1137**
	Working sleeve with dual window, WL 185 mm	**89220.1027**
	Working sleeve with elevator lip, WL 185 mm	**89220.1157**
	Working sleeve with long elevator lip, WL 185 mm	**89220.1167**
	Working sleeve with 30° bevel, WL 185 mm	**89220.1047**
	Working sleeve with 45° bevel, WL 185 mm	**89220.1037**
	Working sleeve with bevel, WL 185 mm	**89220.1147**
	Extension sleeve WL 155 mm	**89220.1407**

Working sleeves, Ø 8.0 mm

Article		Types
	Working sleeve with 30° bevel, WL 120 mm	**89220.3008**
	Working sleeve for foraminoplasty, WL 145 mm	**89220.1018**
	Working sleeve, basic set, WL 165 mm	**89220.1908**
	Working sleeve with long elevator lip, WL 165 mm	**89220.1068**
	Working sleeve with dual window, WL 185 mm	**89220.1028**
	Working sleeve with elevator lip, WL 185 mm	**89220.1088**
	Working sleeve with long elevator lip, WL 185 mm	**89220.1098**
	Working sleeve with 30° bevel, WL 185 mm	**89220.1078**
	Working sleeve with 45° bevel, WL 185 mm	**89220.1038**
	Extension sleeve, WL 155 mm	**89220.1408**

Fluid adaptors

Article		Types
	Fluid adaptor, Ø 7.0 mm	**89220.1307**
	Fluid adaptor, Ø 8.0 mm	**89220.1308**
	Working sleeve attachment, Ø 7.0 mm	**89200.1007**
	Working sleeve attachment, Ø 8.0 mm	**89200.1008**
	Sealing caps, pack of 10	**89.03**

Trephines

Article		Types
	Trephine, WL 195 mm, Ø 5.9 mm, cutting window Ø 3.0 mm	**8792.503**
	Trephine, WL 195 mm, Ø 5.9 mm, cutting window Ø 5.3 mm	**8792.504**
	Trephine, WL 195 mm, Ø 6.9 mm, cutting window Ø 6.3 mm	**89260.1108**

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Accessories

Article		Types
	Small spongiosa funnel, for working sleeve Ø 7.0 mm	**89220.1517**
	Large spongiosa funnel, for working sleeve Ø 7.0 mm	**89220.1527**
	Spongiosa ram, for working sleeve Ø 7.0 mm	**89220.1507**

Shaver system

Article		Types
	Power Drive Art1 shaver system	**2304.0011**
	Double pedal foot-switch	**2304.901**
	Power Stick M4, max. revs/min 6,000 rpm	**8564.021**
	Power Stick M5, max. revs/min 16,000 rpm	**89955.0000**
	Universal conneting cable	**8564.851**
	COMBIDRIVE set	**20951.0000**
	Angled handpiece, high-speed, max. revs/min 40,000 rpm	**82950.1301**

Burrs / rotation knives for Power Stick M4 (Power Drive 2304 and COMBIDRIVE 20951)

Article		Types
	Oval burr, Ø 2.5 mm, WL 350 mm, laterally hooded	**8792.312**
	Nucleus resector, Ø 2.5 mm, WL 350 mm, laterally hooded	**8792.313**
	Nucleus resector, Ø 3.0 mm, WL 350 mm, laterally hooded	**89970.1003**
	Nucleus resector, Ø 3.0 mm, WL 160 mm, laterally hooded	**89970.4003**
	Oval burr, Ø 3.0 mm, WL 350 mm, laterally hooded	**89970.1503**
	Oval burr, Ø 3.0 mm, WL 350 mm, laterally and distally hooded	**89970.1513**
	Nucleus resector, Ø 4.0 mm, WL 350 mm, laterally hooded	**89970.1004**
	Oval burr, Ø 4.0 mm, WL 350 mm, laterally hooded	**89970.1504**
	Oval burr, Ø 4.0 mm, WL 350 mm, laterally and distally hooded	**89970.1514**
	Oval burr, Ø 4.5 mm, WL 220 mm, laterally hooded	**8792.323**
	Nucleus resector, Ø 4.5 mm, WL 220 mm, laterally hooded	**8792.321**

Burrs / rotation knives for Power Stick M5 (Power Drive 2304 and COMBIDRIVE 20951)

Article		Types
	Oval burr, Ø 2.5 mm, WL 350 mm, laterally hooded	**899751502**
	Oval burr, Ø 2.5 mm, WL 350 mm, laterally and distally hooded	**899751512**
	Nucleus resector, Ø 3.0 mm, WL 350 mm, laterally hooded	**899751003**
	Oval burr, Ø 3.0 mm, WL 350 mm, laterally hooded	**899751503**
	Oval burr, Ø 3.0 mm, WL 350 mm, laterally and distally hooded	**899751513**
	Nucleus resector, Ø 4.0 mm, WL 350 mm, laterally hooded	**899751004**
	Oval burr, Ø 4.0 mm, WL 350 mm, laterally hooded	**899751504**
	Oval burr, Ø 4.0 mm, WL 350 mm, laterally and distally hooded	**899751514**
	Ball burr, Ø 2.5 mm, WL 350 mm	**899751302**
	Ball burr, Ø 3.0 mm, WL 350 mm	**899751303**
	Ball burr, Ø 4.0 mm, WL 350 mm	**899751304**

High-speed burrs (for COMBIDIRVE 20951)

Article		Types
	Ball burr, Ø 3.0 mm, WL 350 mm, pack of 3	**82960.3730**
	also: Outer tube, distally hooded, Ø 4.0 mm	**82970.1330**
	Ball burr diamond, Ø 3.0 mm, WL 350 mm, pack of 3	**82960.3930**
	also: Outer tube, distally hooded, Ø 4.0 mm	**82970.1330**
	Ball burr diamond, Ø 4.0 mm, WL 350 mm, pack of 3	**82960.3940**
	also: Outer tube, open, Ø 4.0 mm	**82970.1340**

Irrigation pump system

Article		Types
	Fluid control system 2203	**2203.0011**
	Tube system, disposable, with puncture needle, pack of 10	**4170.223**
	Tube system, disposable, with Safe Lock, pack of 10	**4170.224**

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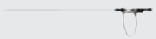
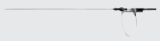
HF / RF generators

Article		Types
	Surgitron radiofrequency unit, 4 MHz	**2343.001/ .002**
	Bipolar generator set	**2352.0011/ .0021**

RF accessories/electrodes

Article		Types
	Trigger Flex handpiece, complete	**8792.691**
	Trigger Flex bipolar electrodes, pack of 6	**4792.6912**
	Spare sheath	**8792.694**

HF instruments, bipolar

Article		Types
	Bipolar micro grasping forceps, Ø 2.6 mm, WL 390 mm	**89930.1010**
	Bipolar inner part, pack of 3	**89930.1001**
	Tube shaft	**89930.1002**
	Handle	**89930.1000**

HF electrodes, bipolar, Ø 2.0 mm, WL 400 mm

Article		Types
	Ring electrode	**8765.613**
	Button electrode	**8765.621**
	Stepped ball electrode	**8765.612**
	Connecting piece	**8765.554**

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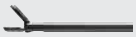
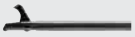
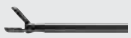
Forceps / punches, Ø 2.0 mm

Article		Types
	Micro-rongeur, WL 290 mm	**892406002**
	Micro-punch, WL 290 mm	**892406202**

Forceps / punches, Ø 2.5 mm

Article		Types
	Micro-rongeur, WL 290 mm	**89240.2025**
	Micro-rongeur, double-action, WL 290 mm	**89240.2125**
	Micro-punch, WL 290 mm	**89240.2225**
	Micro-bone punch, WL 290 mm	**89240.2325**
	Micro-rongeur, WL 360 mm	**8792.632**
	Micro-rongeur, double-action, WL 360 mm	**8792.636**
	Micro-punch, WL 360 mm	**8792.671**
	Micro-rongeur, extended jaws, WL 360 mm	**89240.1125**
	Nucleus grasping forceps, WL 360 mm	**89230.1125**

Forceps / punches, Ø 3.0 mm

Article		Types
	Micro-rongeur, WL 290 mm	**89240.3003**
	Micro-rongeur, double-action, WL 290 mm	**89240.3013**
	Micro-punch, WL 290 mm	**89240.3023**
	Tube shaft punch, WL 290 mm	**89240.3903**
	Micro-rongeur, WL 360 mm	**89240.1003**
	Micro-rongeur, double-action, WL 360 mm	**89240.1013**
	Micro-punch, WL 360 mm	**89240.1023**
	Nucleus grasping forceps, WL 360 mm	**89230.1003**
	Spreader, WL 360 mm	**89230.1803**
	Scissors, WL 360 mm	**89240.1703**
	Tube shaft punch, WL 360 mm	**89240.1903**

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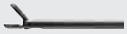
Forceps / punches, Ø 4.0 mm

Article		Types
	Micro-rongeur, WL 290 mm	**89240.3004**
	Micro-rongeur, double-action, WL 290 mm	**89240.3014**
	Micro-punch, WL 290 mm	**89240.3024**
	Tube shaft punch, WL 290 mm	**89240.3904**
	Micro-rongeur, WL 360 mm	**89240.1004**
	Micro-rongeur, double-action, WL 360 mm	**89240.1014**
	Micro-punch, WL 360 mm	**89240.1024**
	Nucleus grasping forceps, WL 360 mm	**89230.1004**
	Micro-rongeur, articulating, WL 360 mm	**89240.1624**
	Tube shaft punch, WL 360 mm	**89240.1904**
	Micro-rongeur, curved, WL 360 mm (fits in 4 mm working channel)	**89240.1044**
	Micro-punch, Ø 2.5 mm, curved, WL 360 mm (fits in 4 mm working channel)	**89240.1034**

Forceps / punches, Ø 5.2 mm for use through the working sleeve

Article		Types
	Intradiscal grasping forceps, articulating, WL 210 mm	**8792.623**
	Intradiscal punch, articulating, WL 210 mm	**8792.663**
	Intradiscal rongeur, conical jaw, articulating, WL 210 mm	**89240.1052**

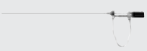
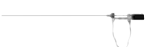
Assorted forceps / punches / scissors for use through the working sleeve

Article		Types
	Punch, Ø 2.7 mm, WL 210 mm	**8792.661**
	Scissors, Ø 2.7 mm, WL 240 mm	**8792.641**
	Grasping forceps, Ø 3.4 mm, WL 240 mm	**8792.621**
	Punch, Ø 3.4 mm, WL 240 mm	**8792.662**
	Suction punch, Ø 4.5 mm, WL 240 mm	**8792.681**
	Rongeur, Ø 4.5 x 4.2 mm, WL 210 mm	**8791.601**
	Rongeur, Ø 4.5 x 4.2 mm, WL 210 mm	**8791.691**

Hand-held / accessory instruments, sharp-edged

Article	Types
 Annulotome, Ø 2.5 mm, WL 290 mm	**89260.2125**
 Bone dissector, Ø 2.5 mm, WL 290 mm	**89260.2225**
 Rasp, Ø 2.5 mm, WL 290 mm	**89260.2325**
 Trocar, Ø 2.5 mm, WL 290 mm	**89260.2425**
 Spoon, Ø 2.5 mm, WL 290 mm	**89260.2525**
 Curette, Ø 2.5 mm, WL 290 mm	**89260.2625**
 Rasp, Ø 2.5 mm, WL 350 mm	**8792.541**
 Trocar, Ø 2.5 mm, WL 350 mm	**8792.551**
 Spoon, Ø 2.5 mm, WL 350 mm	**8792.562**
 Annulotome, Ø 2.5 mm, WL 350 mm	**8792.581**
 Curette, Ø 2.5 mm, WL 350 mm	**8792.571**
 End-cut burr, Ø 3.0 mm, WL 350 mm	**89260.1113**
 End-cut burr, Ø 4.0 mm, WL 350 mm	**89260.1114**

Hand-held / accessory instruments, atraumatic

Article	Types
Elevator, Ø 2.5 mm, WL 290 mm	**89250.2025**
 Hook probe, Ø 2.5 mm, WL 290 mm	**89250.2125**
Probe, Ø 2.5 mm, WL 290 mm	**89250.2225**
 Dissector, Ø 2.5 mm, WL 350 mm	**8792.591**
 Dissector, Ø 3.0 mm, WL 350 mm	**89250.1003**
 Dissector, Ø 4.0 mm, WL 350 mm	**89250.1004**
 Probe with flexible tip, Ø 2.5 mm, WL 350 mm	**892501925**
also:	
 Spare inner probe element, WL 350 mm, pack of 3	**892501625**
 Probe with flexible tip, Ø 2.5 mm, WL 290 mm	**892506925**
also:	
 Spare inner probe element, WL 290 mm, pack of 3	**892506625**

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Accessories

Article		Types
	Positioning probe	**8791.701**
	Instrument grasping forceps	**8793.856**
	"X-Tractor" withdrawal instruments, complete set	**89230.0000**
	"X-Tractor" clamping device, small	**89230.0003**
	"X-Tractor" clamping device, large	**89230.0004**
	"X-Tractor" handle	**89230.0008**
	Mallet	**8866.956**

Suction and irrigation accessories

Article		Types
	Flushing valve, foot-operated	**89870.0000**
	Suction connector	**89270.1000**
	Sucker, Ø 2.5 mm, WL 290 mm	**89270.2025**
	Sucker, Ø 4.0 mm, WL 340 mm	**89270.1004**

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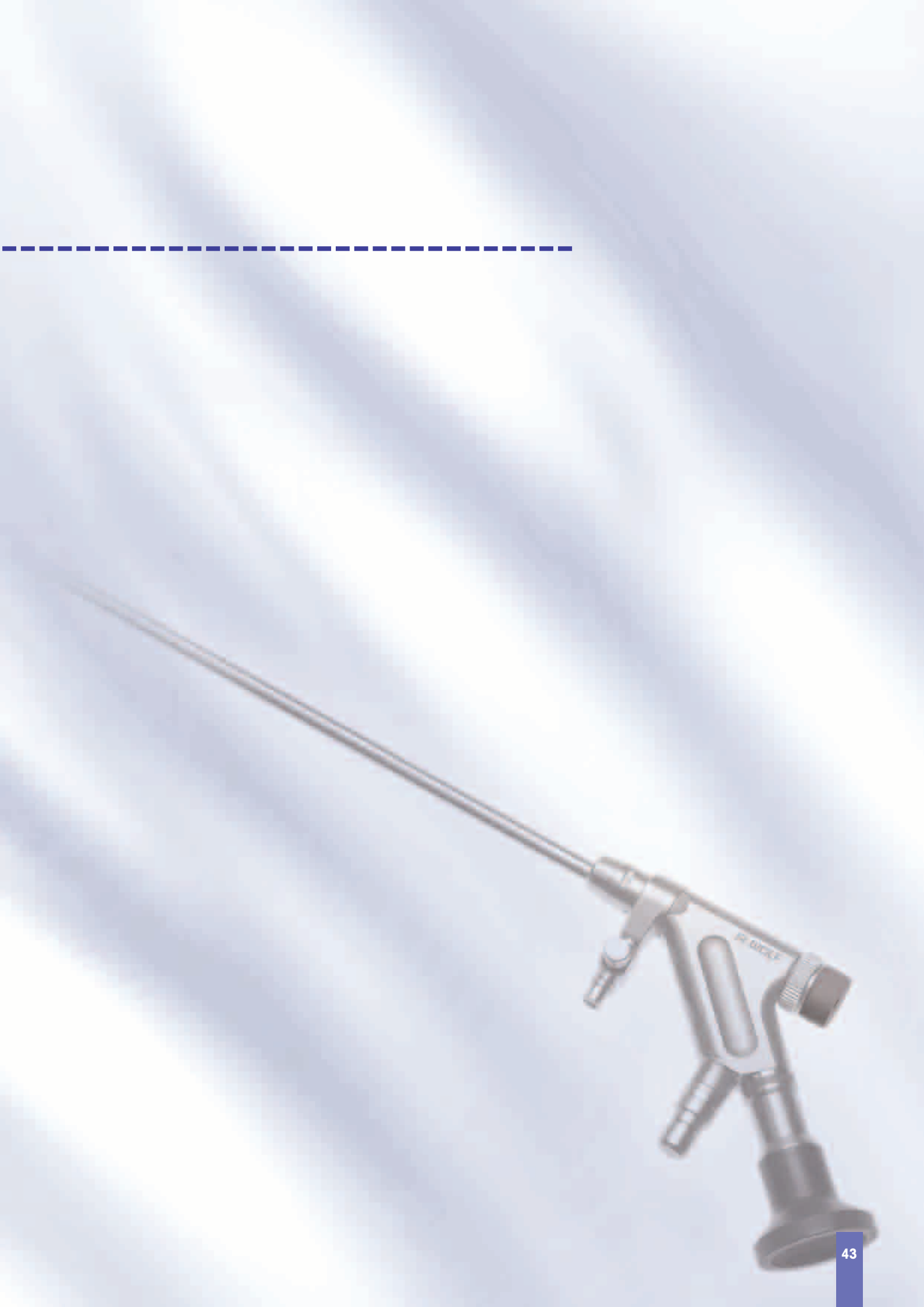
Notes



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