



DEGENERATIVE SPINAL
DISORDERS

AESCLAP PATIENT INFORMATION
**THORACIC AND LUMBAR
SPINE SURGERY**

THORACIC AND LUMBAR SPINE SURGERY



DEAR PATIENT,

Operative interventions on the spine are one of the most frequently performed surgical procedures.

Certainly there is a unique personal history connected with pain, fear and daily-life restrictions before the operative intervention.

The doctors and the professional healthcare team of your hospital are your consultants who will take care of you and support you during your treatment process.

A painless daily life with a high mobility and a recreated life quality is the aim of this path.

The aim of this brochure is to complement the medical advice and to support you by answering your questions, so that finally the remaining uncertainties can be removed.

INFORMATION ABOUT OPERATIONS AT THE THORACIC AND LUMBAR SPINE



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VII AESCULAP AG

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I | SPINAL ANATOMY

1. GENERAL INFORMATION ABOUT SPINE

The spinal column is one of the most important and mobile structures of the human body. It supports and stabilizes the upper part of our body (trunk) and represents the centre of our musculoskeletal system, making our motion sequences possible.

The shape of the vertebrae and the height of the intervertebral discs differ depending on the spinal region.

According to those characteristics, the vertebrae are divided into the following five regions:

- Cervical Spine
- Thoracic Spine
- Lumbar Spine
- Sacrum
- Tailbone (Coccyx)

The human spine usually consists of 33 vertebrae, which are flexibly connected by intervertebral discs. By adult age, the vertebrae of the sacrum fuse together. The adjacent tailbone is attached to the sacrum by fibrous tissue, which permits slight movements of this spinal region. Due to this fact, the adult spine consists of 24 flexibly connected vertebrae.

A disc is situated between two spinal vertebrae, which enables the spine a high radius of movement. Thanks to the shock-absorbing properties, spinal discs serve as a protection system for the spinal vertebrae, the brain and other structures. Additionally, the spinal column and vertebrae protect the spinal cord.

The single anatomical structures are finely adapted to each other, in order to create a highly flexible yet resilient construct which serves for many functions.



I | SPINAL ANATOMY

2. THE FIVE SPINE REGIONS¹

Cervical Spine

- Consists of 7 small vertebrae (C1-C7)
- Backward curvature (lordosis)
- Shows the highest range of motion within the spine
- Begins at the base of the skull and ends above the shoulders

Thoracic Spine

- Consists of 12 vertebrae (T1-T12)
- Forward curvature (kyphosis)
- Compared to the rest of the spine it shows a very low range of motion
- Has connection points for ribs

Lumbar Spine

- Consists of 5 large vertebrae (L1-L5)
- Backward curvature (lordosis)
- Vertebrae and discs are thicker than the other vertebrae and carry most of the body's weight
- Allows motion, especially in flexion and extension (e.g. seat and stand up)

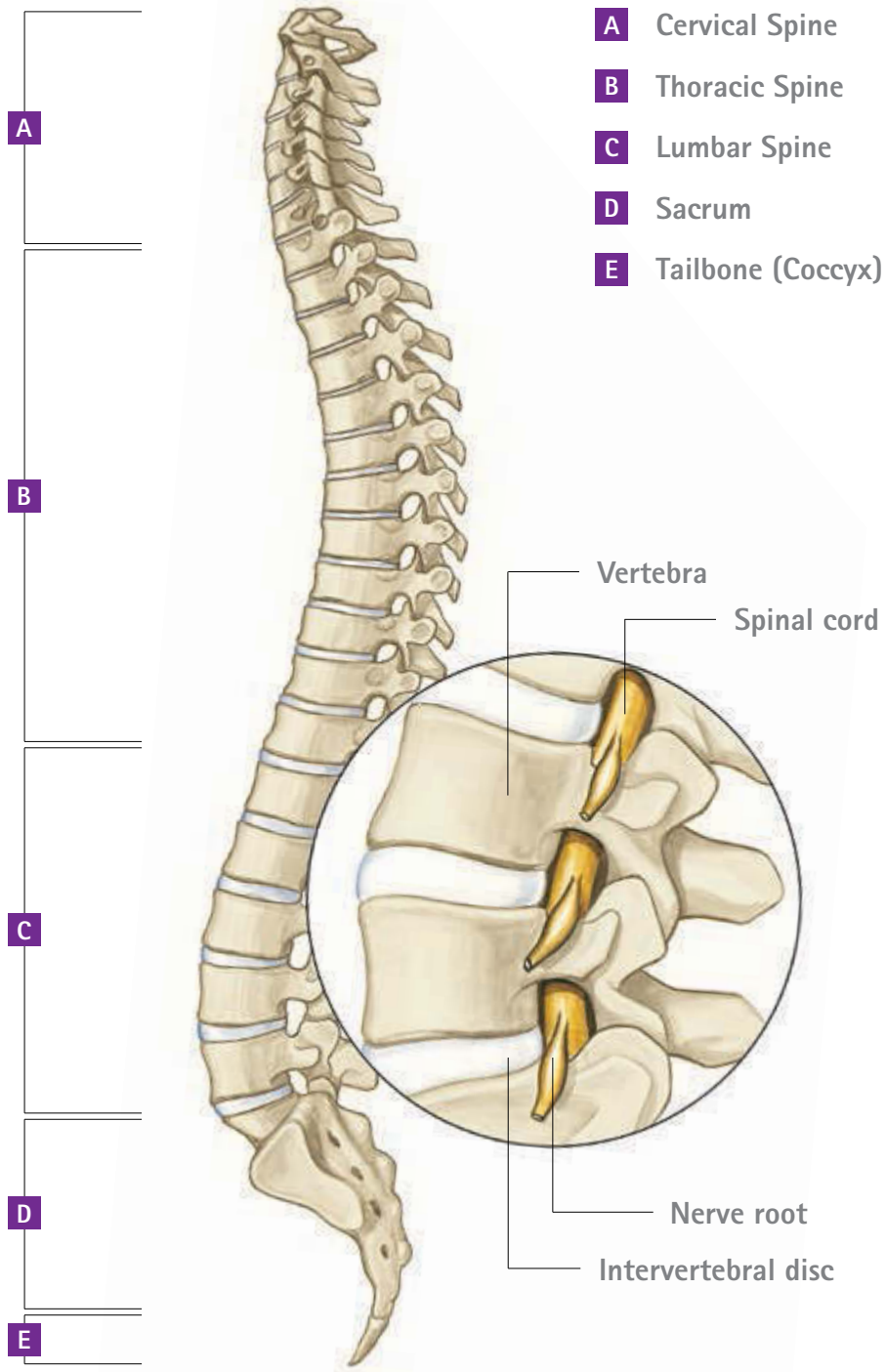
Sacrum

- Consists of 5 fused vertebrae (S1-S5)
- Forward curvature (kyphosis)
- Connects to the pelvis

Tailbone (Coccyx)

- Usually consists of 4 vertebrae
- Attachment point for spinal muscles

¹ Gregory D. Cramer, Susan A. Darby. *Clinical Anatomy of the Spine, Spinal Cord, and ANS - E-Book*. 3rd edition. Elsevier Health Science. 2017; 9780323082310.



I | SPINAL ANATOMY

3. THE NERVE STRUCTURE OF THE SPINE

The spinal cord is a slender cylindrical shaped structure composed of nervous tissue. It begins from the back of the head and extends down to the intervertebral disc space between the first and second lumbar vertebra and is protected by the surrounding bony structures of the vertebra.

The spinal cord is the biggest nerve structure of the body and is an essential part of the central nervous system.

It works as a conduit for motion information, sensory information (e.g. sense of touch) and as a coordination system for certain reflexes.

The lateral openings (foramina) of the vertebrae permit the passage of the spinal nerve roots, which emerge from the spinal cord at each level on both sides of the vertebra. The nerve roots are responsible for movements and stimulating feeling like pain.

The intervertebral discs are placed between each pair of vertebrae allowing the spine to show a large range of motion. Due to its shock absorbing characteristics, the intervertebral discs work mainly as protection system for the vertebrae, spinal cord and other spinal structures.

The spinal cord and its branching off nerve roots are responsible for the complex interaction between the spinal structures and the brain. These enable us to be mobile and to feel sensations. In case of an injury or an impaired function of the spine, the effects may be painful and obstructive. Depending on the spinal region, the manifestation of pain can differ:

Cervical Spine

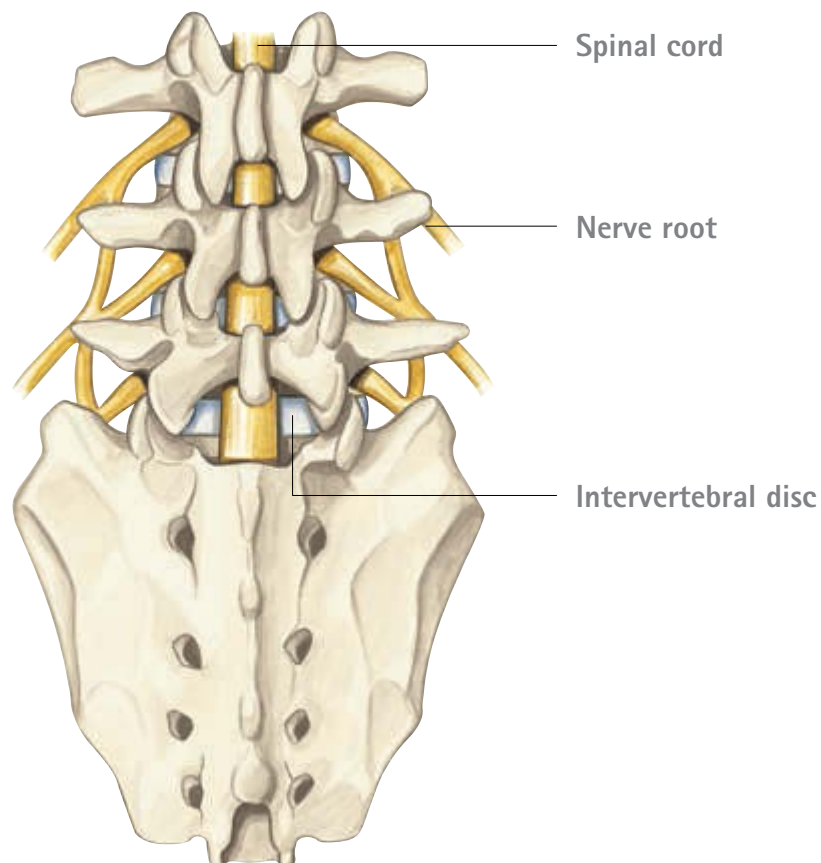
- Neck pain with reduced range of motion
- Headaches
- Pain in shoulder, arms, and/or hands
- Weakness, numbness and slower reflexes or tingle in arms, hands, legs, and/or feet

Lumbar Spine

- Pain in the lower back that spreads in one or both legs or buttock
- Tingling, numbness or loss of sensation in one or both legs
- Weakness of muscles in one or both legs
- Slower or loss of reflexes in one or both legs

Lumbar Spine with Sacrum

(View from back)



II | REASONS FOR A SPINE SURGERY

1. DEGENERATIVE DISC DISEASE

During the natural aging process of the spine, the intervertebral disc will exhibit changes in its consistency with a varying degree of degeneration. In this case the intervertebral disc gradually loses the ability to function efficiently and maintain height, which can lead to back pain.

2. VERTEBRAL DISPLACEMENT (SPONDYLOLISTHESIS)

Describes the forward displacement of a vertebra in relation to the vertebrae below. Often the lumbar spine is affected by this spinal condition, because it bears the most weight relative to other regions of the spine.

3. INTERVERTEBRAL DISC HERNIATION

The affected intervertebral disc shows tears in the outer structure, so that the inner gelatinous part of the disc bulges out of the herniated disc. The spinal cord and its nerve roots can become pinched which can lead to various symptoms.

4. SPINAL STENOSIS

Spinal stenosis describes an abnormal narrowing of the space where the spinal cord and the corresponding nerve roots pass. This narrowing causes a serious restriction of the spinal cord and nerve roots resulting in neurological deficits.

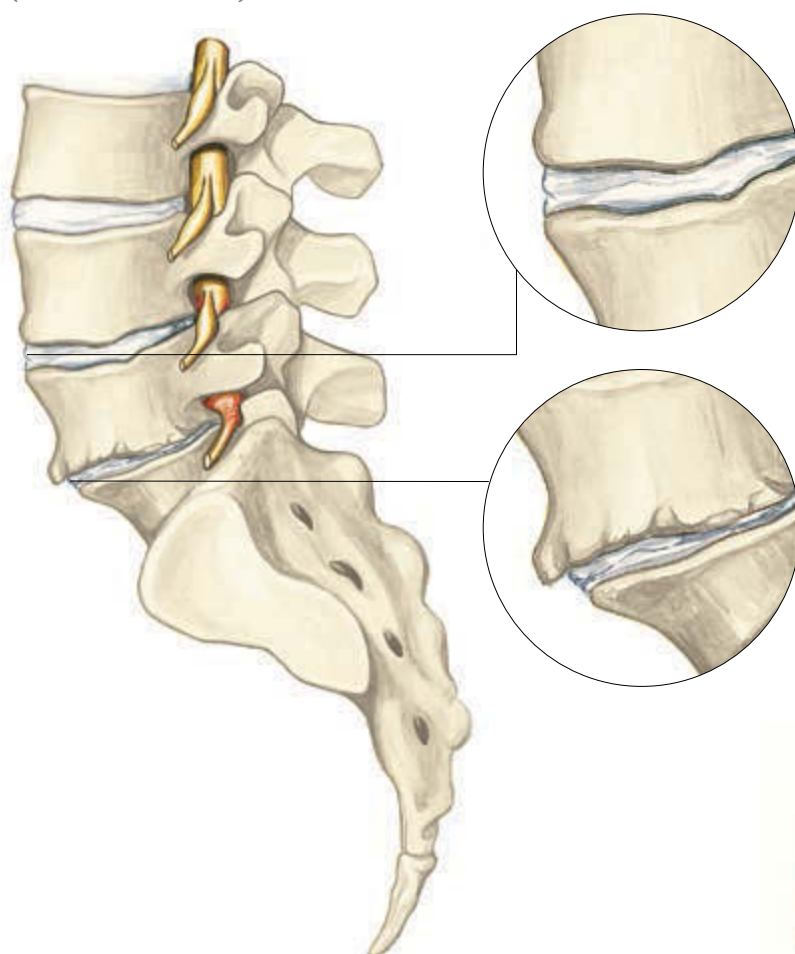
5. LATERAL CURVATURE (SCOLIOSIS / DEFORMITY)

Viewed from the back, a typical spine shows a straight contour. In the case of a scoliosis or deformity, the spine shows abnormal sideways curvatures which influence the posture in a critical way.

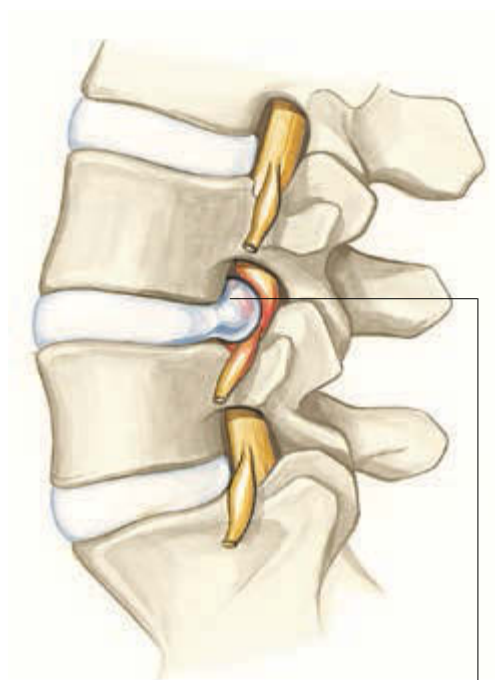
6. VERTEBRAL BREAKAGE (FRACTURE)

Vertebral fractures are caused by trauma (e.g. accidents) or unfavorable spinal conditions such as osteoporosis. The consequences of a fractured vertebra can be serious. Bone fragments can pinch or damage the spinal cord and the nerve roots.

Lumbar Spine with Sacrum
(View from lateral)



Degenerated
intervertebral disc



Herniated intervertebral disc

III | MINIMAL INVASIVE SURGERY

1. WHAT IS MINIMAL INVASIVE SURGERY?

The term "minimal invasive surgery" generally describes a surgical technique that allows the surgeon to access the body through small incisions. In view of a spinal surgery, this means that the surgeon operates through small skin incisions in your back, resulting in reduced muscle trauma and better cosmetic outcomes.

The access to the spine is performed by using specialized instruments such as gentle retraction blades. Through these, the surgeon is able to treat your spine while keeping the incision small.

2. WHAT ARE THE BENEFITS OF MINIMAL INVASIVE SURGERY?

Compared to a traditional open surgical technique the minimal invasive approach may lead to:

- Quicker recovery and return to normal activities^{1,2}
- Shorter hospital stay^{1,2}
- Less post-operative pain^{2,3}
- Less blood loss and need for blood transfusion^{2,3}
- Less damage to skin and spinal musculature^{2,3}
- Less risk of infection^{1,2,4}

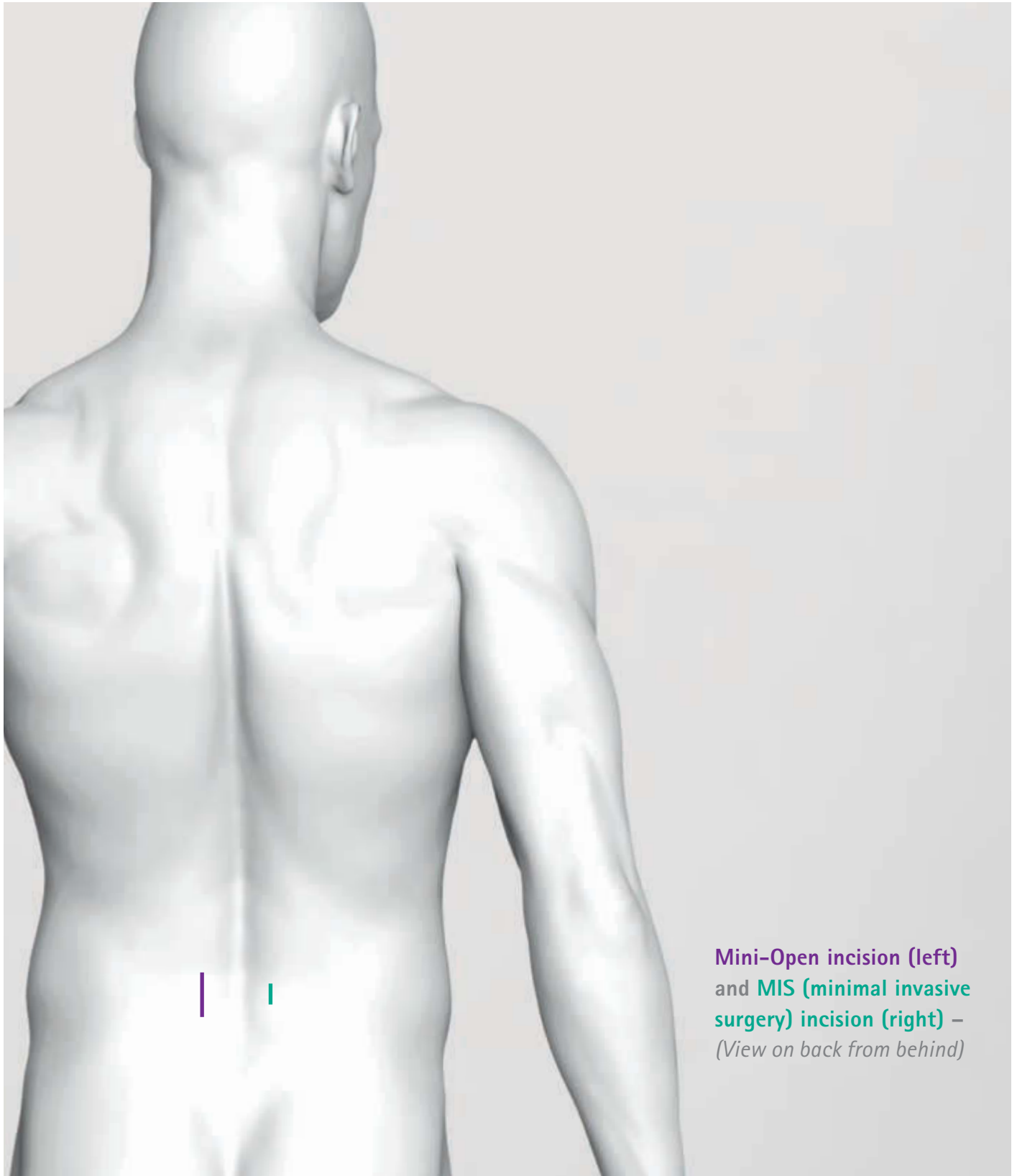
Depending on your spine condition, your surgeon will plan an individual treatment concept including the surgical procedure and special instructions for your post-operative recovery.

1 Singh K. *Minimally Invasive Spine Surgery: An Algorithmic Approach*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd. 2013.

2 M. Pishnamaz, U. Schemmann, C. Herren, K. Horst, P. Lichte, F. Hildebrand, H.-C. Pape, P. Kobbe. Muscular changes after minimally invasive versus open spinal stabilization of thoracolumbar fractures: A literature review. 2018. *J Musculoskelet Neuronal Interact* 2018; 18(1):62-70.

3 Hsiang J, Yu K, He Y. Minimally invasive one-level lumbar decompression and fusion surgery with posterior instrumentation using a combination of pedicle screw fixation and transpedicular facet screw construct. *Surgical Neurology International*. 2013 Jan 1;4(1):125.

4 Rhee J, Wiesel S, Boden S, Flynn J. *Operative Techniques in Spine Surgery*. Philadelphia: Lippincott Williams & Wilkins. 2013.



Mini-Open incision (left)
and MIS (minimal invasive surgery) incision (right) –
(View on back from behind)

III | MINIMAL INVASIVE SURGERY

3. HOW IS MINIMAL INVASIVE SURGERY DONE?

The first step during a minimal invasive back surgery is represented by the skin incision and the retraction of the spinal muscles, including surrounding tissues. Thereby the surgeon gets access and a good view on the area of the spine, which will be operated.

In some cases your surgeon performs a decompression, which creates more space for the spinal cord, by removing a portion of the back part of the vertebral body (laminectomy).

It is also possible that your surgeon decides to perform a micro discectomy, which is a partial removal of intervertebral disc material that compresses the nerves or the spinal cord.

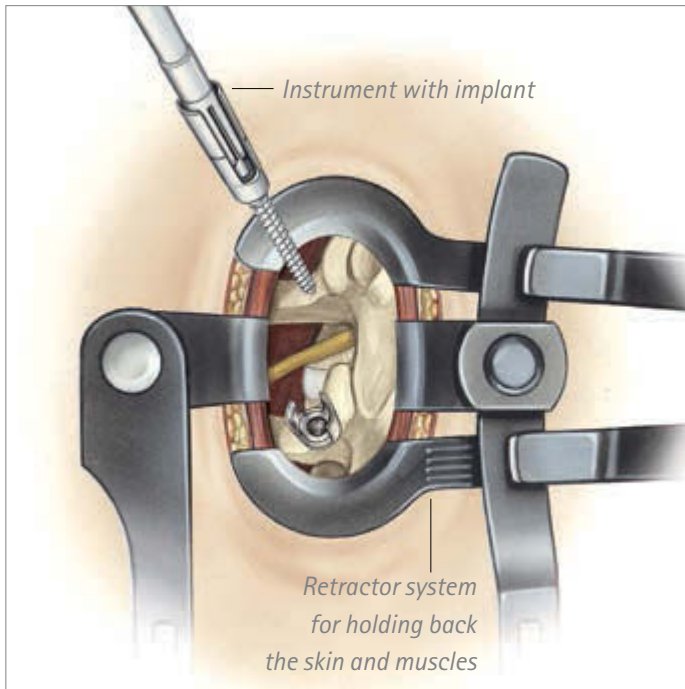
4. INTERVERTEBRAL IMPLANTS

Apart from that it is possible, that the surgeon may consider that removing the intervertebral disc and replacing it by an implant is useful.

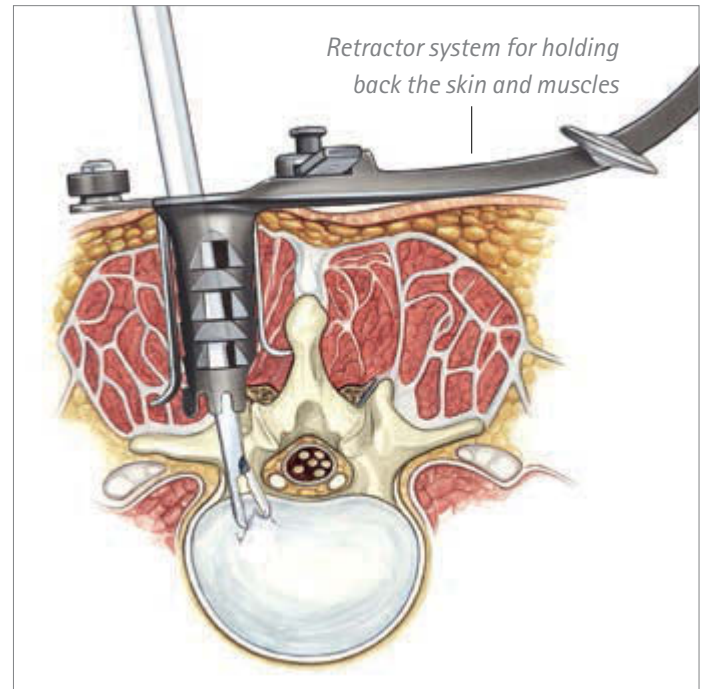
After the removal of the entire intervertebral disc an implant is placed, in order to restore the natural disc height and to support the bone bridge between the vertebral bodies (fusion).

5. SCREW-ROD-SYSTEMS

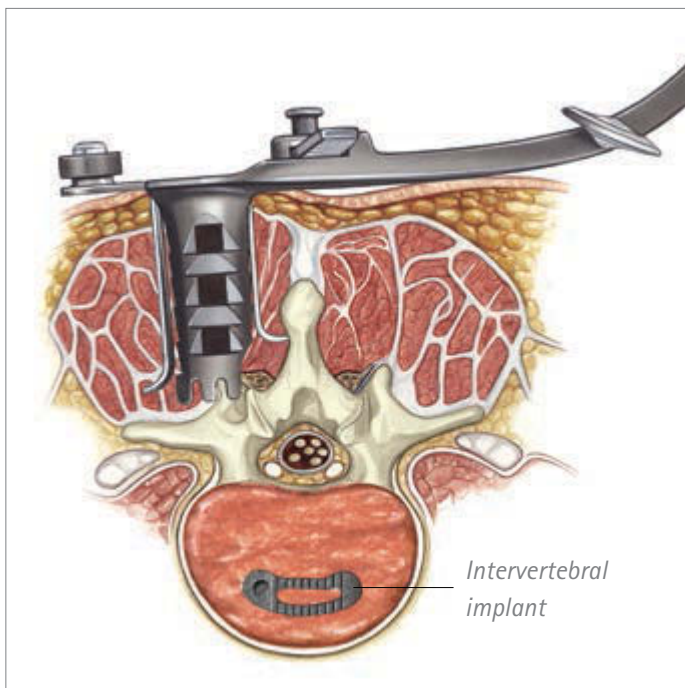
In addition to the intervertebral implant screws (pedicle screws) are frequently inserted in the back of the spine and connected with stable rods. Thereby the spine can be stabilized and the fusion process can be optimized.



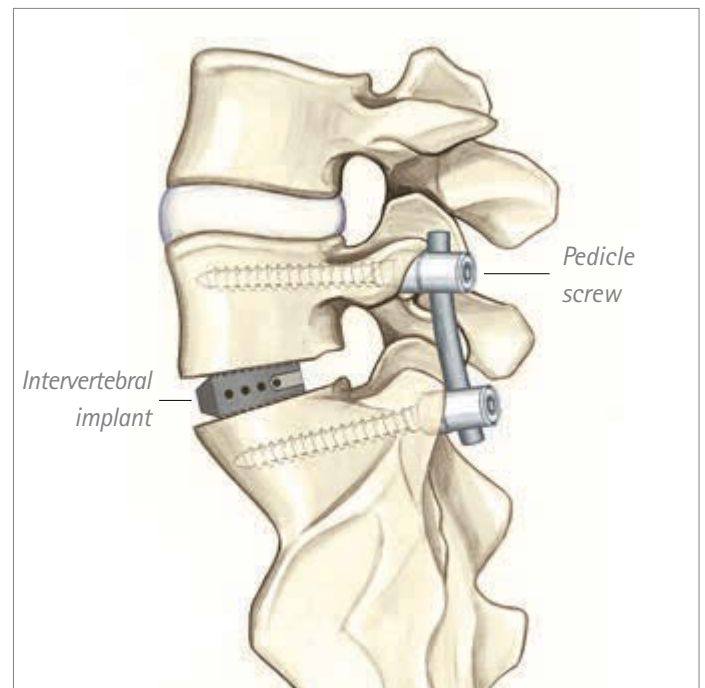
View onto the spine from behind through a minimal invasive approach



Removal of the intervertebral disc through minimal skin incision (View from above – cranial)



Treatment with an intervertebral implant (View from above – cranial)



Treatment of a lumbar spine with an intervertebral implant and a screw-rod-system (View from lateral)

IV | IMPLANT SYSTEMS

1. SCREW-ROD-SYSTEMS

AESCULAP® Ennovate®

The Ennovate® system is a screw-rod-system that unlocks new possibilities in the treatment of the spine. Thanks to its special designed implants, Ennovate® allows adaptation of the treatment concept according to the patient anatomy and its individual needs. In addition, Ennovate® is suitable for a comprehensive range of approaches and indications, such as degenerative diseases and scoliosis. This offers the patient the best possible treatment for its spinal disease.

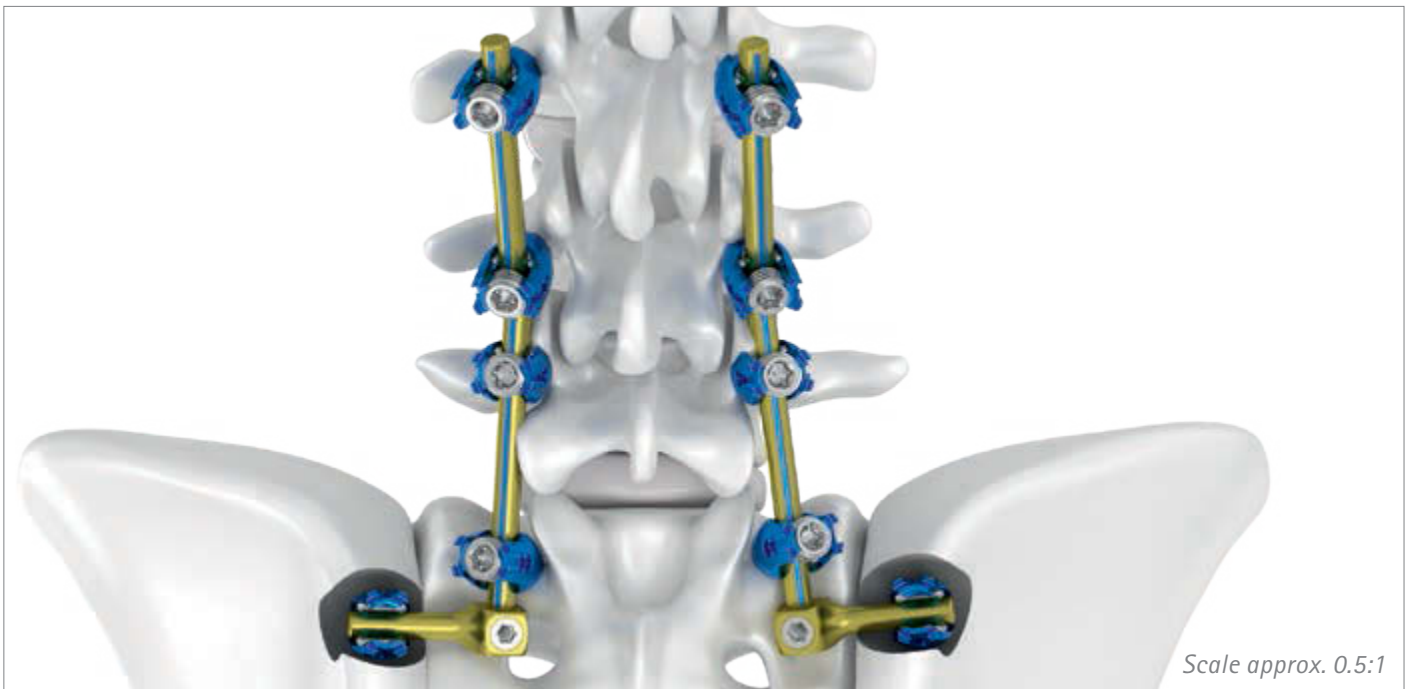
Ennovate® is characterized by its high mechanical performance, providing a stable spinal fixation for positive patient outcome.¹

Ennovate® also complements with the Aesculap intervertebral implants and vertebral replacement implants, for a complete treatment concept of the spine.

¹ Data on file at B. Braun Aesculap. Core Indication: Degenerative Spinal Disorders.



AESCULAP® Ennovate® Two-level spinal fusion with pedicle screws (AESCULAP® Ennovate®). A connector is used for further construct stability (View from back)



AESCULAP® Ennovate® Multilevel spinal fusion with pedicle screws (AESCULAP® Ennovate®). Two lateral connectors are used for construct extension (View from back)

IV | IMPLANT SYSTEMS

2. INTERVERTEBRAL IMPLANTS

PROSPACE® XP & TSPACE® XP

- PROSPACE® XP and TSPACE® XP are implants to stabilize one or more segments of the thoracic and the lumbar spine. They were specially created to meet the requirements of today's minimally invasive operation technique.
- The X-ray transparent material of PROSPACE® XP and TSPACE® XP enables a fast and uncomplicated evaluation of the bone structure and the stiffening process. Radiographic markers made of tantalum are used during the operation and the post-control to verify the position.
- The long-term stability of the implant is improved by the special pure-titanium-coating called Plasmapore XP®. This enables the bone cells to grow into the porous surface of the implant.
- The mechanical stiffness of 3.6 GPa, complies with the natural bone, which makes an ideal power transmission between the material of the implant and the bone possible.

Arcadius XP L®

- Mostly spine surgeries are performed from behind. Under certain conditions a treatment from the front may be more reasonable. In this case an intervertebral disc is removed by a 4–6 cm long incision through the abdominal wall and replaced by a disc prosthesis (see also Aesculap Patient Information "The artificial disc") or by a spacer if a fusion is strived for.
- Intervertebral implants which are used for fusion operations are either secured additionally from behind by pedicle screws or themselves have possibilities of bone fixation (Arcadius XP L®).



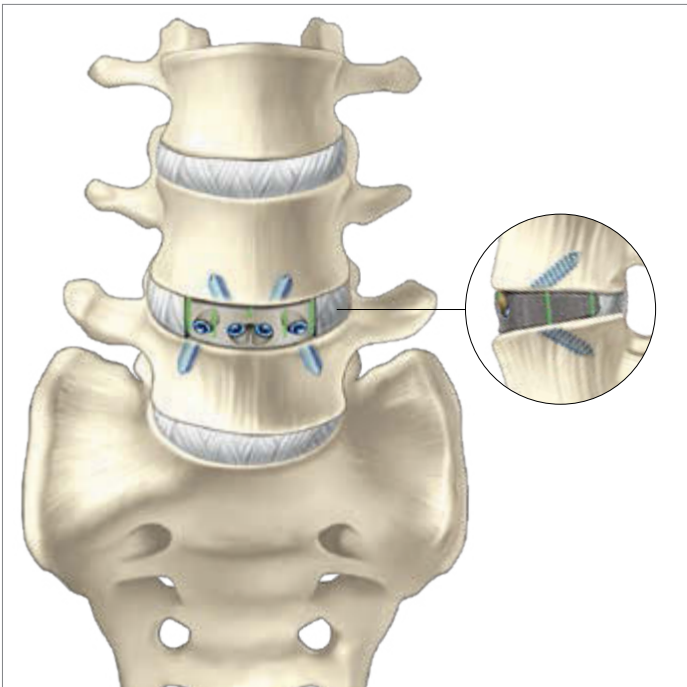
PROSPACE® XP used for posterior lumbar interbody fusion



Plasmapore XP® innovative surface technology made of porous titanium for enhanced stability



Arcadius XP L® stand-alone interbody device to stabilize the lumbar spine by anterior access



Arcadius XP L® with titanium screws for fixation in the bone (*View from front*)

IV | IMPLANT SYSTEMS

3. VERTEBRAL BODY REPLACEMENT

Hydrolift®

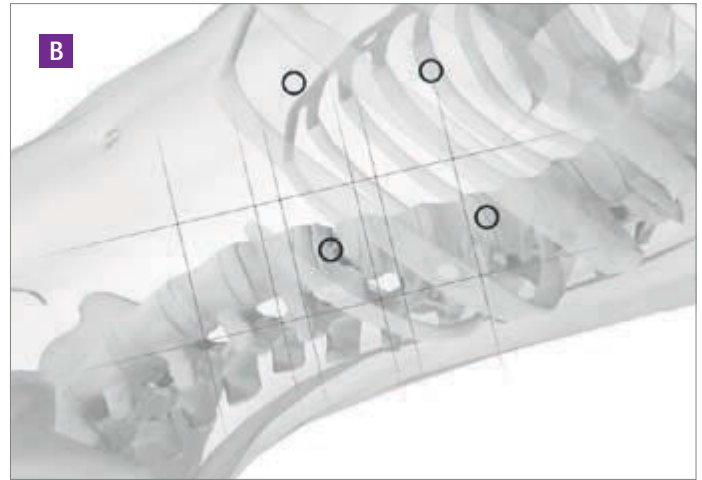
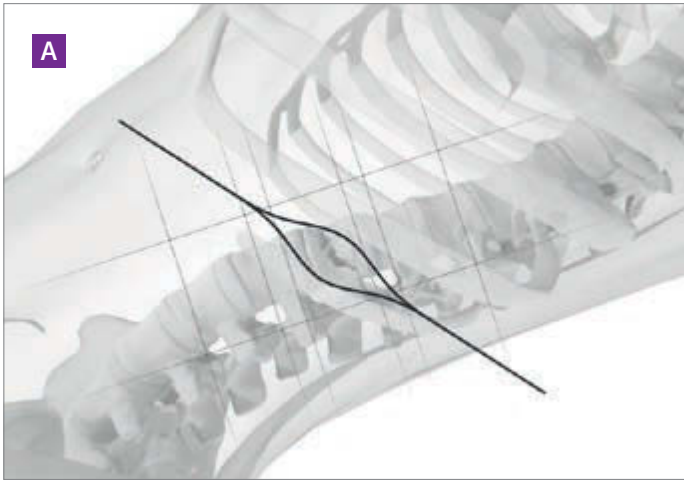
When a vertebral body is seriously damaged, that a removal is necessary, then a so called vertebral body replacement implant (e.g. Hydrolift®) will be implanted.

This implant bridges the space over between the adjacent vertebral bodies and thus supports the spine.

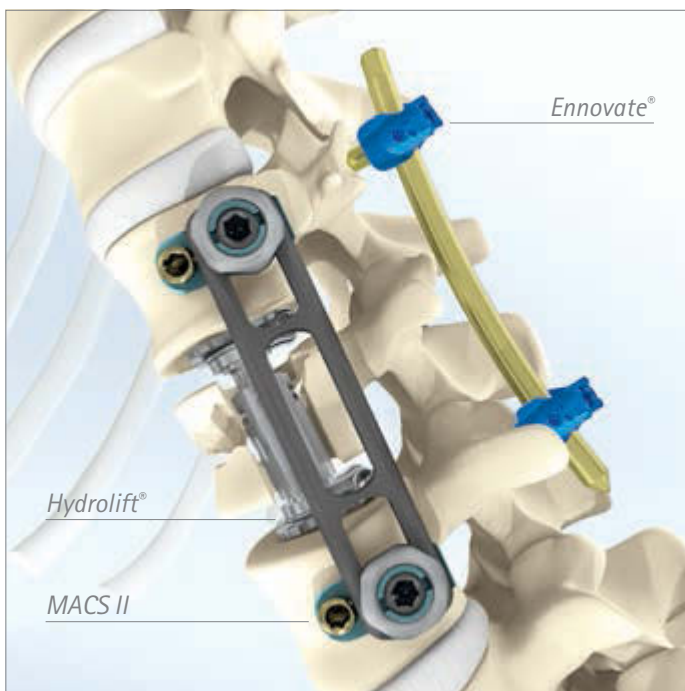
Besides the vertebral body replacement a screw-rod-construct (e.g. Ennovate®) and/or a screwable plate (e.g. MACS II) will be implanted to gain additional stability.

Besides their original function, modern implants systems like Hydrolift® and MACS II offer besides their original function further advantages like the opportunity for a endoscopic assisted implantation.

At this procedure instead of a single quite large approach (**A**) to the operation field only four little incisions (**B**) are made. Then the surgical instruments are inserted through a trocar (tube). In this way the caused wound trauma can be reduced and, consequently, the scarring minimised.



Approach to the thoracolumbar spine from the left patient side – Minimal invasive (*left picture*) and endoscopic assisted (*right picture*)



Treatment with a vertebral body replacement (Hydrolift®), an additional plate (MACS II) and a rod-screw-system (Ennovate®) (*View from lateral*)

V | BEFORE THE OPERATION

1. WHAT ARE MULTI-DRUG-RESISTANT ORGANISMS (MDRO)?

Each day we get in contact with numerous germs (e.g. bacteria or viruses) with whom our immune system has to deal with. In most cases the protective mechanism in our body is successful and such germs do not pose a danger.

Due to the increased use of antibiotics in humans and animals, some bacteria have mutated genetically. This is mainly due to the combination of incorrect application of the right antibiotics and short duration of intake. This situation allow bacteria to become resistant to several antibiotics, that means they are multi-drug-resistant.

2. WHO IS ESPECIALLY ENDANGERED?

Multi-drug resistant germs become dangerous and cause infections only when they are entering the body through a wound in the skin and causing infections. There is a higher risk for patients after an operation with acute skin injuries and chronic wounds.

3. WHAT CAN AFFECTED PERSONS DO?

For an optimal preparation of your upcoming operation we suggest a preventive body wash with the Prontoderm®-System. Hereby you can contribute actively to reduce the risk of the incidence of wound infections.¹ The treatment should begin up to five days before the planned surgery takes place and should include the skin/mucosa, nasal atrium as well as mouth and throat. With the practical decolonisation products Prontoderm® from B.Braun you receive all products required.

More information ➤ <http://www.bbraun.com/en/patients.html>

1 Zywił MG et al. Advance pre-operative chlorhexidine reduces the incidence of surgical site infections in knee arthroplasty. *Int Orthop*. 2011 Jul; 35(7): 1001–6.



B. Braun's Prontoderm® is an easy to use product system. It is effective against Multi-Drug-Resistant-Organisms (MDRO) on skin and mucosa and reduces the infection risks.¹

VI | AFTER THE OPERATION

The following recommendations are no general recommendations and can differ from patient to patient. The whole situation is influenced by factors as age, sporting experience and your physical general health. Therefore please contact your doctor directly.

1. THE FIRST STEPS

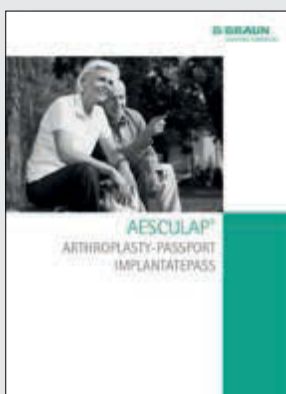
During the first 3 weeks after a spinal operation tranquility and relaxation should outweigh – especially while lying the pressure on the spine is at the minimum.

Normally adequate behaviors for the daily life should be learned during the stationary stay. These are correct standing, sitting, changing of position, position while washing and housework; ideal lifting, handlebar and sitting position while driving the car and accurate work out.

2. REHABILITATION

Usually the physiotherapy begins a few days after the operation. The therapy is oriented to stabilize the abdominal and back muscles. Apart from that the correct motion sequences which promote the health maintenance of the spine should be learned. These exercises should be also continued after the hospital stay.

3. THE ENDO-PROSTHESIS PASS



The endo-prosthesis pass which the patient gets after the operation is an important component while travelling, especially for the identity check at the airport, because the people scanner can react to the metallic components.

The pass proves one's identity as an implant carrier and serves as the identification and documentation of the inserted implants through the pasted labels. There are also the follow up appointments listed.

It is recommended to keep the endo-prosthesis pass in a safe place or carry it with you.



VI | AFTER THE OPERATION

4. FOLLOW-UP EXAMINATIONS

For achieving a long-term success, regular follow-up examinations are necessary, where among other things, the integration of the implant components in or on the bones are evaluated through radiographs. Apart from that the long-term success of a spine surgery depends on the after treatment and the behavior after the surgery. After having learned the behavior patterns during the rehabilitation, the everyday life with situation-related burdens continues.

5. TIPS AND TRICKS FOR DAILY LIFE

Below you find some recommendations for the daily life, especially for the first 6 months after the surgery.

To avoid:

- Abrupt and jerky/impulsive movements, especially jerky stooping
- Strong and disproportionate weight increase
- Heavy lifting and heavy lifting in a bent position
- Fast rotary movement
- Garden work
- Long walks
- Long sitting

Recommendation to facilitate the everyday life:

- Good, flat and nonslip flat footwear
- Shoes with Velcro fastener or elastic shoelaces
- Removing of tripping hazards as carpet edges, discarded items
- Seat cushion as an underlay

Sexuality:

Generally spoken the one who wants to save its back should rather choose the passive part.

Especially during the initial phase you should make sure that all movements can be performed painless.



VI | AFTER THE OPERATION

6. SPORTS

Generally the different sports differ in their spine compatibility. The "straight ahead sports", as walking are finely compatible. Sports which requires coordination and response skills or constant changes of position are not recommended for spine patients (e.g. squash or tennis).

Shock movements, such as jumping from a higher distance, as well as movements which are done jerkily and in repetitive cycles or requiring a high movement range should be prevented.

Suitable type of sports:

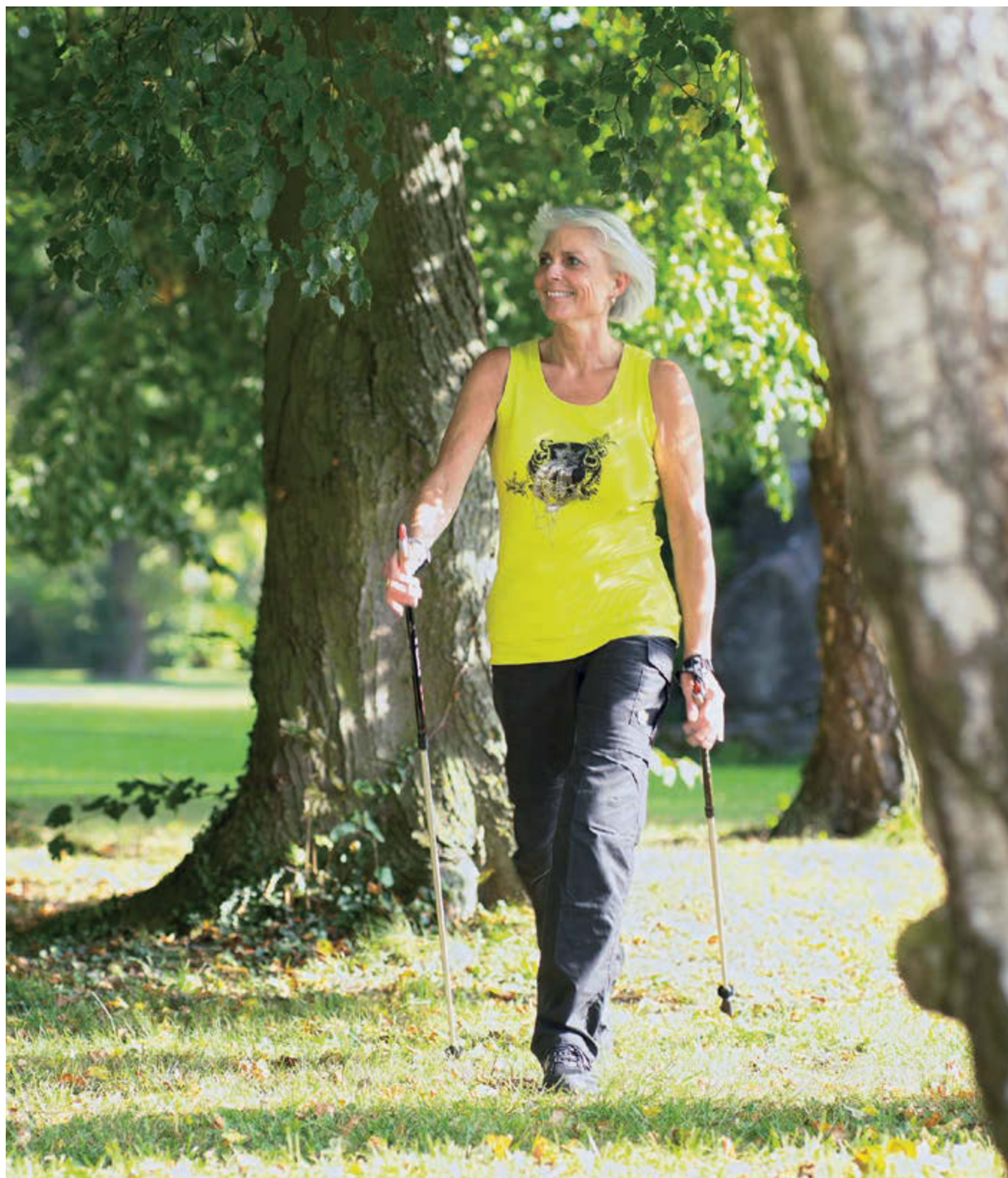
- Biking
- Swimming
- Hiking
- Nordic Walking
- Cross-country skiing
- Gymnastics
- Dancing (Standard or Latin American Dances)

In consultation with your doctor the following sport types might be taken into consideration:

- Golf
- Jogging (on a forest floor, tartan track)
- Strength training

Less suitable type of sports:

- Ball games and team sports as football, handball, basketball
- Squash
- Horse riding
- Tennis
- Alpine skiing



1. INTRODUCTION OF THE MANUFACTURER

With more than 150 years of experience Aesculap sets standards in the surgery. The worldwide 14.200 employees, thereof approximately 3.500 in the head-quarter in Tuttlingen, connect their knowledge and develop products and solutions for all core businesses in the surgery sector.

Whether surgical instruments, suture material, implants or sterile containers Aesculap always strives for innovations which bring medical progress thanks to consequent research and development.

As a member of the family-owned B. Braun Melsungen AG, the division Aesculap merges tradition and modern spirit due to an extensive wealth of experience of more than 35 years in the sector of spine surgery.

One of the most modern production plants for implants within Europe is located at the production site in Tuttlingen, where all components for artificial hip and knee joint replacement, spine implants and screws, plates and nails for bone fractures are manufactured.

The production site in Tuttlingen has a own very modern biomechanical lab where the implants undergo different stress tests.

As a German quality manufacturer Aesculap offers you the opportunity within the Aesculap patient days to look behind the scenes and to experience the high quality.

For further information please visit our patient website.

www.bbraun.com/patientinfo/spine



This patient information is provided by Aesculap AG and is intended to provide you with general information about anatomy, pathology and treatment options how spine surgery can be performed.

A detailed consultation with your surgeon can not be replaced by this patient information.

Please contact your surgeon for additional information and clarification of questions about the anatomy, pathology and treatment options of the spine.

NOTES



AESCULAP® – a B. Braun brand

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