



# A Patient's Guide to the Disorders of the Cervical and Upper Thoracic Spine



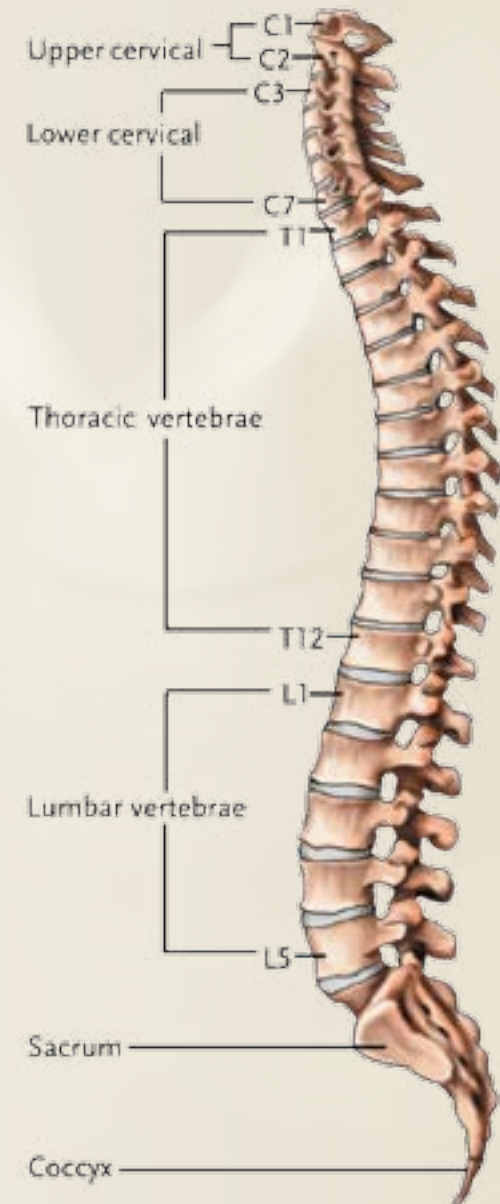
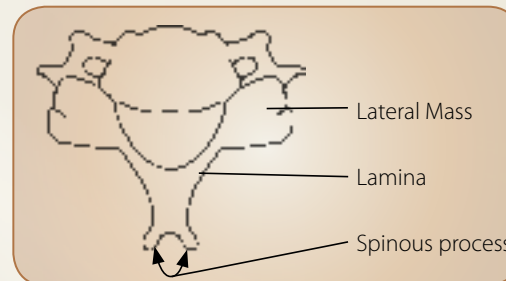
# General Anatomy of the Spine

The spine can be divided into four regions based on vertebral shape and sagittal plane curve.

- » **CERVICAL:** The top seven vertebrae (C1 – C7). The skull is often considered to be part of the spine, and is referred to as C0.
- » **THORACIC:** The next 12 vertebrae (T1 – T12).
- » **LUMBAR:** The final five “true” vertebrae (L1 – L5).
- » **SACROCOCCYGEAL:** Nine fused vertebrae form the sacrum and the coccyx.

Each vertebra is designated with a letter indicating the topographic region (C, T, L and S) and the number of order. For example: C6 is the sixth cervical vertebra; T8 is the eighth thoracic vertebra. The first two cervical vertebrae are the only vertebrae with specific names; C1 is called the atlas and C2 is called the axis.

The fifth lumbar vertebra (L5) may be congenitally partially or completely fused with the upper sacrum. This is called sacralization of L5. Occasionally, the first sacral segment (S1) may remain a separate bone, resulting in six lumbar vertebrae, called lumbarization of S1.

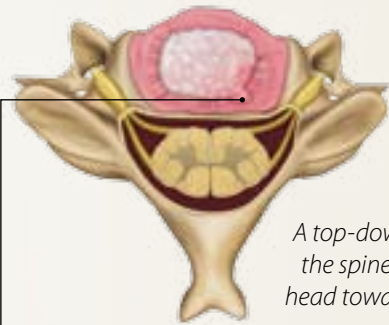


# Pathologies



It is important that you discuss the potential risks, complications, and benefits of these treatments with your doctor prior to receiving treatment and that you rely on your physician's judgment. Only your doctor can determine whether you are a suitable candidate for spinal surgery.

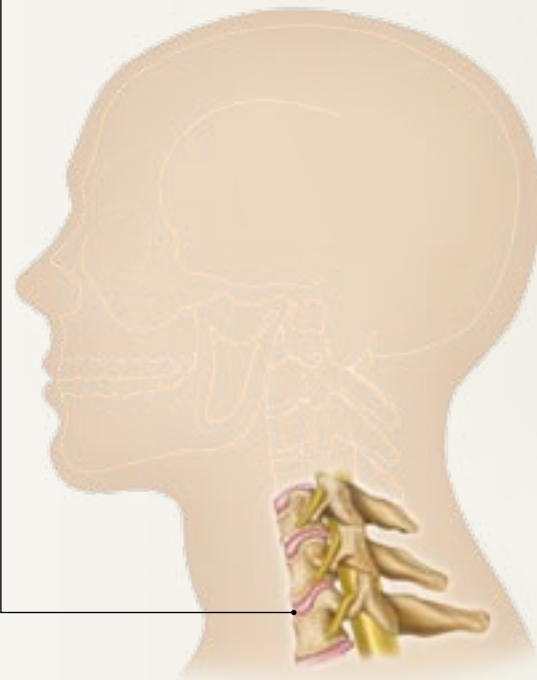
# Degenerative Disease



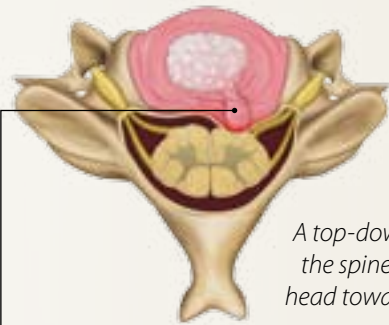
*A top-down view of the spine from the head toward the feet.*

The term degenerative disease refers to the loss of normal tissue structure and function as a result of the aging process. Degenerative disease may also result in pain. Degenerative disease involves the intervertebral disc, the vertebral body, and/or the facet joint. There are many types of degenerative disease including herniated disc, radiculopathy, facet joint pathologies, cervical spondylotic myelopathy, and osteophytes (also known as bone spurs).

## Degenerative Disease



# Herniated Disc



*A top-down view of the spine from the head toward the feet.*

A herniated disc is when the nucleus of the intervertebral disc pushes out from the center of the disc. It may place pressure on the spinal cord or nerve root causing symptoms.

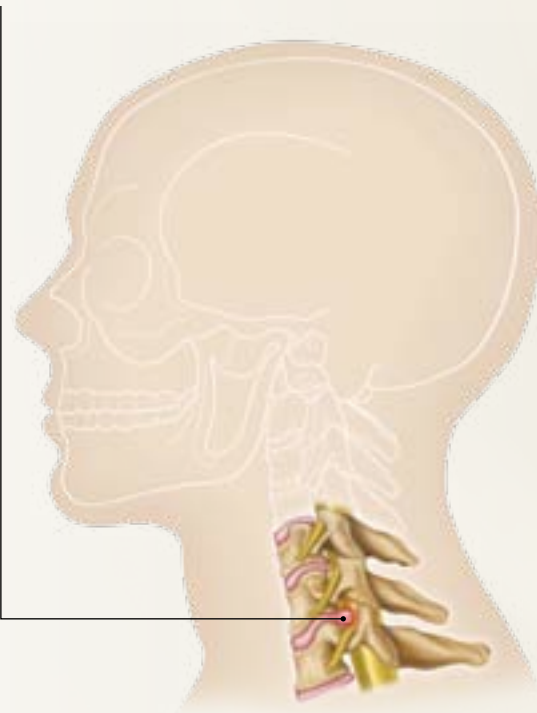
### Symptoms may include:

- » Neck pain
- » Arm pain – Radiculopathy (compression of the nerve root)
- » Myelopathy (compression of the spinal cord)

### Common surgical solutions include:\*

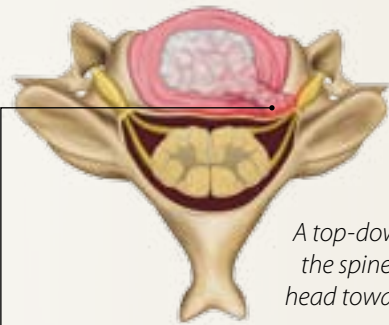
- » Anterior Cervical Discectomy
- » Anterior Cervical Discectomy and Fusion
- » Anterior Cervical Discectomy and Artificial Disc Replacement
- » Posterior Cervical Foraminotomy

## Herniated Disc



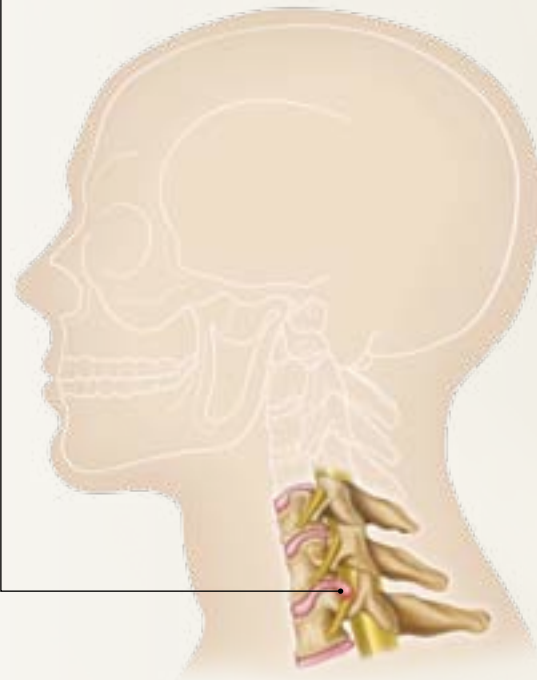
\*See treatment options section for procedural details.

# Cervical Radiculopathy



*A top-down view of the spine from the head toward the feet.*

## Cervical Radiculopathy



Radiculopathy is when a spinal nerve root is irritated and/or compressed by either a herniated disc, osteophyte (bone spur), or both.

### Symptoms of radiculopathy may include:

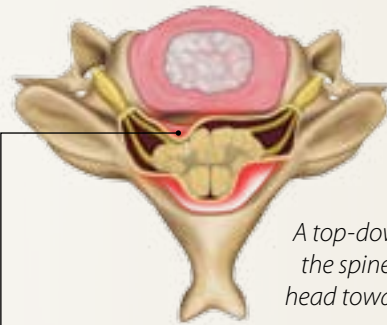
- » Pain in extremities
- » Tingling in extremities
- » Numbness in extremities
- » Muscle weakness
- » Reflex loss
- » Neurapraxia – temporary loss of function

### Procedural solutions include decompression of the nerve root through:\*

- » Anterior Cervical Discectomy
- » Anterior Cervical Discectomy and Fusion
- » Anterior Cervical Discectomy and Artificial Disc Replacement
- » Posterior Cervical Foraminotomy

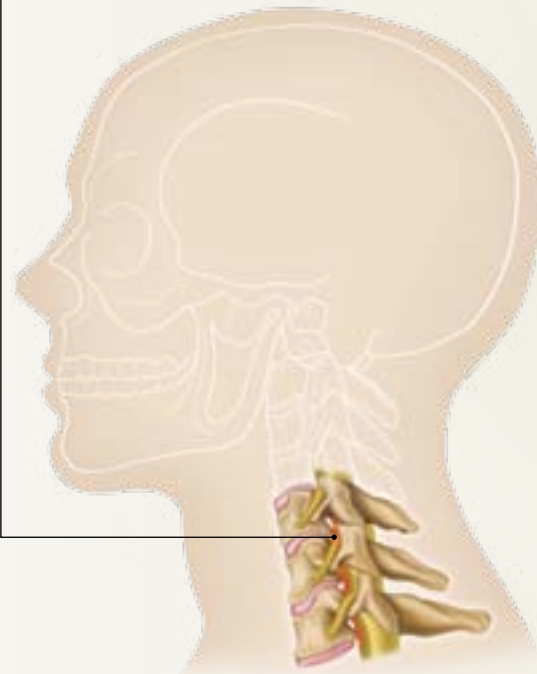
\*See treatment options section for procedural details.

# Cervical Spondylotic Myelopathy



*A top-down view of the spine from the head toward the feet.*

## Cervical Spondylotic Myelopathy



Cervical Spondylotic Myelopathy results from spinal cord compression due to the narrowing of the spinal canal. It can be caused by either congenital conditions or by degenerative changes over time. These degenerative changes, also known as “spondylosis”, result in the growth of bone spurs (osteophytes) which may compress the spinal cord.

### Symptoms of myelopathy may include:

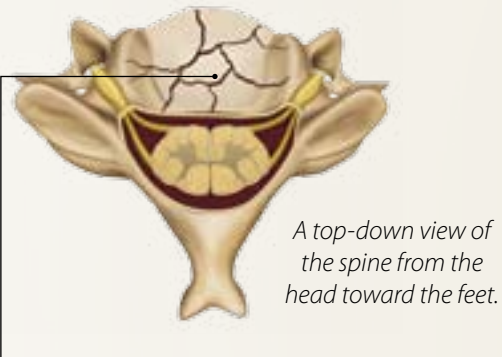
- » Loss of fine motor control of hands
- » Motor weakness in the upper and/or lower extremities
- » Gait/walking difficulties
- » Pain in the neck and/or shoulder area
- » Sensory changes in the lower extremities
- » Upper and lower motor neuron findings such as bowel and bladder dysfunction

### Procedural solutions include:\*

- » Anterior Cervical Decompression and Fusion
- » Posterior Cervical Laminectomy with or without Fusion
- » Posterior Cervical Laminoplasty

\*See treatment options section for procedural details.

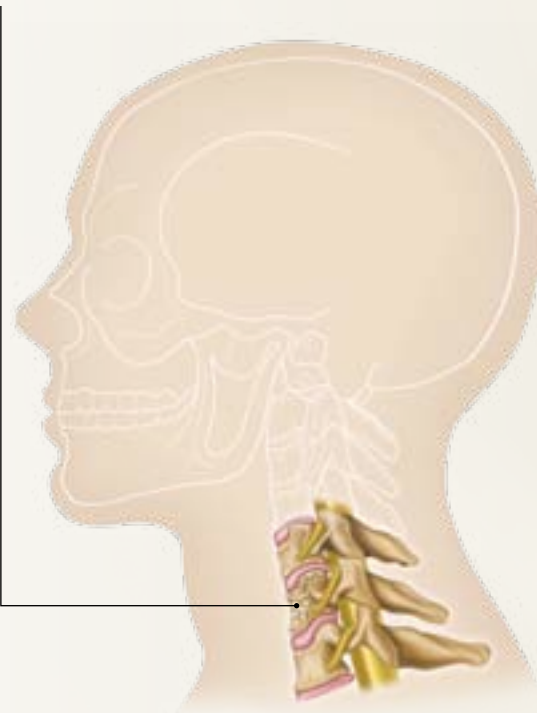
# Trauma in the Cervical Spine



Trauma or fractures occur when an injury occurs to the cervical spine. This results in mechanical instability of the vertebral column and possible neurological injury.

Fractures can be classified as stable or unstable. A stable fracture involves no significant displacement of the bone or soft tissue. An unstable fracture involves deformity of the spine.

## Trauma Fracture



- » A **burst fracture** is when the vertebra breaks and displaces into the spinal canal.
- » A **compression fracture** is when a small portion of the anterior vertebral body is compressed but no bone is displaced into the canal. They usually are shaped like a teardrop or wedge.
- » A **Jefferson's fracture** is a burst fracture of the C1 ring vertebral body.
- » A **Hangman's fracture** is a fracture of the posterior (back) side of the C2 vertebral body.

### Symptoms include:

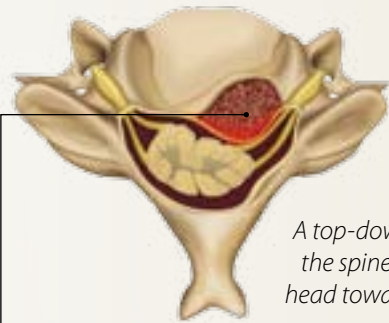
- » Pain in the area of the fracture
- » Neurological defects

### Procedural solutions include:\*

- » Bracing or traction and observation
- » Anterior Cervical Discectomy and Fusion
- » Posterior Cervical Fusion

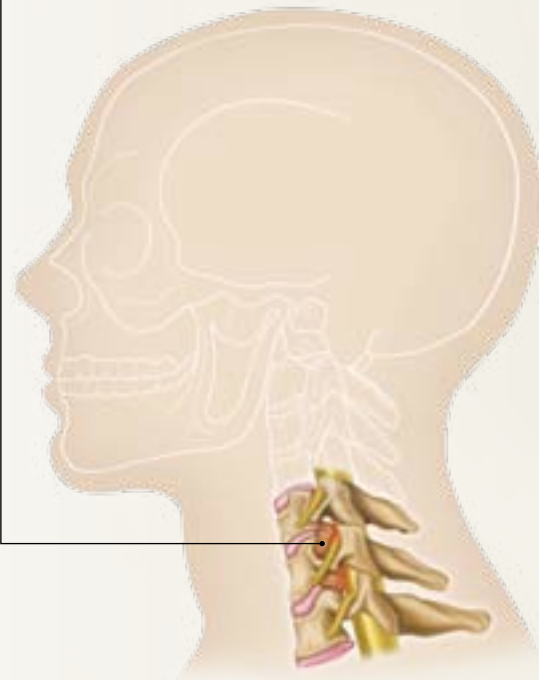
\*See treatment options section for procedural details.

# Cervical Tumors



*A top-down view of the spine from the head toward the feet.*

Tumor



When a tumor is found on the cervical spine it may be removed. Removal of a tumor may cause mechanical instability in the cervical spine.

## Symptoms may include:

- » Pain
- » Weakness
- » Numbness
- » Sensory changes
- » Gait/walking difficulty

## Procedural solutions include:\*

- » Anterior Tumor Removal and Fusion
- » Posterior Laminectomy and Tumor Removal with Fusion

\*See treatment options section for procedural details.

# Treatment Options



It is important that you discuss the potential risks, complications, and benefits of these treatments with your doctor prior to receiving treatment and that you rely on your physician's judgment. Only your doctor can determine whether you are a suitable candidate for spinal surgery.

Please see package insert for a complete list of indications, warnings, precautions, and other important medical information.

# Anterior Cervical Discectomy and Fusion (ACDF)

This procedure uses an anterior (from the front of the neck) approach of the spine at the affected levels. First, the **intervertebral disc(s)** that is/are causing the problem is removed. This is commonly referred to as a discectomy. Then the empty space is filled with bone graft. This allows a fusion to occur. A fusion occurs when the bones grow together creating a bond between the two **vertebrae**. A plate is then positioned over the bone graft to provide immediate, temporary stability for the anterior cervical spine while the bone graft (s) try to fuse. The plate is attached to the affected levels using screws. Plates may potentially be used in patients who have received a diagnosis from their doctor of **degenerative disc disease**, trauma, tumors, deformity, **pseudoarthrosis** and/or a failed previous fusion. There are potential risks associated with the use of these devices some of which include: disassembly, bending, and/or breakage of any or all of the components, pressure on the skin from the plate which could cause skin penetration, irritation, and/or pain, tissue or nerve damage, scar formation, interference with imaging of the area, and other risks.

## Medtronic solutions include:

- » ATLANTIS® Anterior Cervical Plate System
- » ATLANTIS TRANSLATIONAL™ Anterior Cervical Plate System
- » ATLANTIS VISION® Anterior Cervical Plate System
- » ATLANTIS VISION® ELITE Anterior Cervical Plate System
- » ZEPHIR® Anterior Cervical Plate System
- » VENTURE® Anterior Cervical Plate System



These therapies are not for everyone. Please consult your physician. A prescription is required. For further information about our products, please call Medtronic at (800) 933-2635 and/or go to [www.medtronic.com](http://www.medtronic.com).

# Additional Anterior Cervical Discectomy and Fusion (ACDF) Options

An alternative to plates uses an anterior (from the front of the neck) approach of the spine at the affected level. First, the **intervertebral disc** that is causing the problem is removed. This is commonly referred to as a discectomy. Then the empty space is filled with an interbody fusion device and bone graft. This allows a fusion to occur. A fusion occurs when the bones grow together creating a bond between the two **vertebrae**. PEEK PREVAIL® is attached to the affected level with screws and provides immediate stability as the bone grafts try to fuse. The PEEK PREVAIL® Cervical Interbody Device is indicated for anterior cervical interbody fusion procedures in skeletally mature patients with cervical disc disease at one level from the C2-C3 disc to the C7-T1 disc. Cervical disc disease is defined as intractable radiculopathy and/or myelopathy with herniated disc and/or osteophyte formation on posterior vertebral endplates producing symptomatic nerve root and/or spinal cord compression confirmed by radiographic studies. There are potential risks associated with the use of this device some of which include: disassembly, bending, and/or breakage of any or all of the components, screw backout, collapse of the intervertebral disc space in which the device is inserted, and other risks.

Another alternative to plates also uses an anterior (from the front of the neck) approach of the spine at the affected level (s). First, the **intervertebral disc** (s) that is/are causing the problem is removed. This is commonly referred to as a discectomy. Then the empty space is filled with bone graft. This facilitates the bone growing together in order to create a bond between the two vertebrae. A device is then positioned over the bone graft. The MYSTIQUE™ System, in conjunction with traditional rigid fixation, is intended for use in spinal fusion procedures as a means to maintain the relative position of weak bony tissue such as allografts or autografts. This device is not intended for load bearing indications. There are potential risks associated with the use of this device some of which include: disassembly, bending, and/or breakage of any or all of the components, pressure on the skin from the device which could cause skin penetration, irritation, and/or pain, tissue or nerve damage and scar formation.

## Medtronic solutions include:\*

- » MYSTIQUE® Resorbable Graft Containment Plating System\*
- » PEEK PREVAIL® Cervical Interbody Device\*\*

\* The MYSTIQUE® System, in conjunction with traditional rigid fixation, is intended for use in spinal fusion procedures as a means to maintain the relative position of weak bony tissue. This device is not intended for load-bearing indications.

\*\* ZEPHIR® System screws must be used with PEEK PREVAIL® Cervical Interbody Device.

These therapies are not for everyone. Please consult your physician. A prescription is required. For further information about our products, please call Medtronic at (800) 933-2635 and/or go to [www.medtronic.com](http://www.medtronic.com).



# Anterior Cervical Discectomy and Artificial Disc Replacement

This procedure uses an anterior (front) approach to the spine. First, the diseased **intervertebral disc** is removed (discectomy) and a surgical decompression of the spinal cord and spinal nerve roots is performed. An artificial disc is then positioned in the space that is created from the discectomy and decompression. Along with the benefits of these technologies there are potential risks. Some of these risks include neck and/or arm pain, swallowing difficulties, speech difficulties, and infection. The PRESTIGE® Cervical Disc and the BRYAN® Cervical Disc were both designed to allow for motion in the cervical spine. The PRESTIGE® Disc is designed to allow for mobility through two stainless steel articulating components, a ball component on top that rotates and slides within

a trough component on the bottom. The BRYAN® Cervical Disc is made of two metal (titanium) shells and a mobile inner polyurethane (plastic) core. It is designed to provide motion by allowing movement between the two metal components and the plastic component. The PRESTIGE® Cervical Disc and BRYAN® Cervical Disc are indicated in skeletally mature patients for reconstruction of the disc from C3-C7 following single-level discectomy for intractable radiculopathy and/or myelopathy.

#### Medtronic solutions include:

- » BRYAN® Cervical Disc System
- » PRESTIGE® Cervical Disc System



*BRYAN® Cervical Disc System*



*PRESTIGE® Cervical Disc System*

Please see the patient education brochure for each product for the complete list of indications, warnings, precautions, adverse events, clinical results, and other important medical information.

Please see page 14 for additional important safety information.

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#### **BRIEF SUMMARY OF INDICATIONS, CONTRAINDICATIONS, AND WARNINGS FOR THE PRESTIGE® CERVICAL DISC:**

The PRESTIGE® Cervical Disc is indicated in skeletally mature patients for reconstruction of the disc from levels C3-C7 following single-level discectomy for intractable radiculopathy and/or myelopathy. The PRESTIGE® device is implanted via an open anterior approach. Intractable radiculopathy and/or myelopathy should present with at least one of the following items producing symptomatic nerve root and/or spinal cord compression which is documented by patient history (e.g., pain [neck and/or arm pain], functional deficit, and/or neurological deficit), and radiographic studies (e.g., CT, MRI, x-rays, etc.): 1) herniated disc, and/or 2) osteophyte formation.

The PRESTIGE® Cervical Disc should not be implanted in patients with an active infection or with an allergy to stainless steel.

The PRESTIGE® Cervical Disc should only be used by surgeons who are experienced in the surgical procedure and have undergone adequate training with the device. A lack of adequate experience and/or training may lead to a higher incidence of adverse events, such as neurological complications.

The safety and effectiveness of this device has not been established in patients with the following conditions: more than one cervical level with DDD; not skeletally mature; clinically significant cervical instability; prior fusion at adjacent cervical level; severe facet joint pathology of involved vertebral bodies; prior surgery at treated level; osteopenia, osteomalacia, or osteoporosis as defined by bone mineral density T-score of -3.5, or -2.5 with vertebral crush fracture; spinal metastases; chronic or acute renal failure or history of renal disease; taking medications known to potentially interfere with bone/soft tissue healing (e.g. steroids); pregnant; cervical instability; severe insulin dependent diabetes; and were not refractory to at least six weeks of unsuccessful conservative treatment or had signs of progression or spinal cord/nerve root compression with continued non-operative care.

Implanted metal alloys release metallic ions into the body (especially those devices with metal-on-metal articulating surfaces). The long term effect of these ions on the body is not known.

Caution: Federal law (USA) restricts this device to sale by or on the order of a physician.

**Please see the package insert for the complete list of indications, warnings, precautions, adverse events, clinical results, and other important medical information.**

#### **BRIEF SUMMARY OF INDICATIONS, CONTRAINDICATIONS, AND WARNINGS FOR THE BRYAN® CERVICAL DISC:**

The BRYAN® Cervical Disc is indicated in skeletally mature patients for reconstruction of the disc from C3-C7 following single-level discectomy for intractable radiculopathy and/or myelopathy. The BRYAN® device is implanted via an open anterior approach. Intractable radiculopathy and/or myelopathy is defined as any combination of the following: disc herniation with radiculopathy, spondylotic radiculopathy, disc herniation

with myelopathy, or spondylotic myelopathy resulting in impaired function and at least one clinical neurological sign associated with the cervical level to be treated, and necessitating surgery as demonstrated using computed tomography (CT), myelography and CT, and/or magnetic resonance imaging (MRI). Patients receiving the BRYAN® Cervical Disc should have failed at least six weeks of non-operative treatment prior to implantation of the BRYAN® Cervical Disc.

The BRYAN® Cervical Disc should not be implanted in patients with an active infection or with an allergy to titanium, polyurethane or ethylene oxide residues., active systemic infection or infection at the operating site; osteoporosis defined as a DEXA bone mineral density T-score equal to or worse than -2.5; moderate to advanced spondylosis characterized by bridging osteophytes, marked reduction or absence of motion, or collapse of the intervertebral disc space of greater than 50% of its normal height; marked cervical instability on radiographs (e.g., radiographic signs of subluxation greater than 3.5 mm or angulation of the disc space more than 11 degrees greater than adjacent segments); significant cervical anatomical deformity or compromised vertebral bodies at the index level (e.g., ankylosing spondylitis, rheumatoid arthritis, or compromise due to current or past trauma); significant kyphotic deformity or significant reversal of lordosis; or symptoms necessitating surgical treatment at more than one cervical level.

The BRYAN® Cervical Disc should only be used by surgeons who are experienced in the surgical procedure and have undergone adequate training with the device. A lack of adequate experience and/or training may lead to a higher incidence of adverse events, such as neurological complications.

The safety and effectiveness of this device has not been established in patients with the following conditions: axial neck pain as solitary symptom; not skeletally mature; prior cervical spine surgery, including prior surgery at the index level; facet joint pathology of involved vertebral bodies; active malignancy; Paget's disease, osteomalacia, or other metabolic bone disease; chronic or acute renal failure or history of renal disease; taking medications known to potentially interfere with bone/soft tissue healing (e.g. steroids); pregnant; unstable cardiac disease: diabetes mellitus requiring daily insulin management; and extreme obesity as defined by the NIH Clinical Guidelines Body Mass Index (i.e., BMI  $\geq 40$ ); less than 21 years of age and were not refractory to at least six weeks of unsuccessful conservative treatment or had signs of progression or spinal cord/nerve root compression with continued non-operative care.

Implanted metal alloys release metallic ions into the body. The long term effect of these ions on the body is not known. Patients in the clinical study were instructed to use non-steroidal anti-inflammatory drugs (NSAIDs) for two weeks postoperatively. Dosing and frequency were left to the discretion of the physician. It has been reported in the literature that short-term postoperative use of NSAIDs may reduce the instance of heterotopic ossification

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# Posterior Occipitocervical-Upper Thoracic Fusion

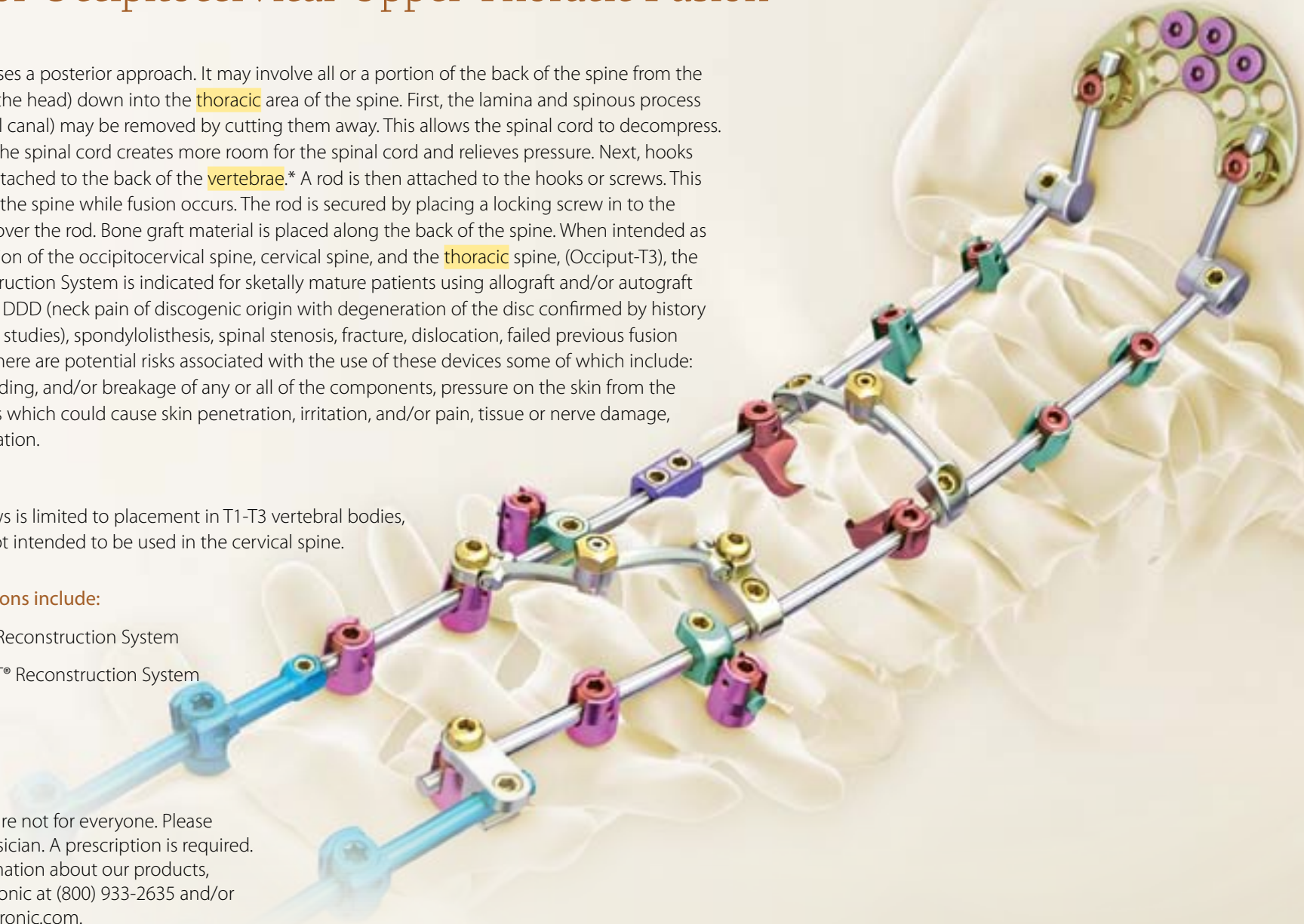
This procedure uses a posterior approach. It may involve all or a portion of the back of the spine from the occiput (back of the head) down into the **thoracic** area of the spine. First, the lamina and spinous process (roof of the spinal canal) may be removed by cutting them away. This allows the spinal cord to decompress. Decompressing the spinal cord creates more room for the spinal cord and relieves pressure. Next, hooks and screws are attached to the back of the **vertebrae**.\* A rod is then attached to the hooks or screws. This helps to stabilize the spine while fusion occurs. The rod is secured by placing a locking screw in to the hooks or screws over the rod. Bone graft material is placed along the back of the spine. When intended as an adjunct to fusion of the occipitocervical spine, cervical spine, and the **thoracic** spine, (Occiput-T3), the VERTEX® Reconstruction System is indicated for skeletally mature patients using allograft and/or autograft for the following: DDD (neck pain of discogenic origin with degeneration of the disc confirmed by history and radiographic studies), spondylolisthesis, spinal stenosis, fracture, dislocation, failed previous fusion and/or tumors. There are potential risks associated with the use of these devices some of which include: disassembly, bending, and/or breakage of any or all of the components, pressure on the skin from the component parts which could cause skin penetration, irritation, and/or pain, tissue or nerve damage, and/or scar formation.

\*The use of screws is limited to placement in T1-T3 vertebral bodies, the screws are not intended to be used in the cervical spine.

## Medtronic solutions include:

- » VERTEX MAX® Reconstruction System
- » VERTEX SELECT® Reconstruction System

These therapies are not for everyone. Please consult your physician. A prescription is required. For further information about our products, please call Medtronic at (800) 933-2635 and/or go to [www.medtronic.com](http://www.medtronic.com).



# Posterior Cervical Laminoplasty

This procedure uses a posterior approach. First, the lateral mass is separated from the lamina on one side of the back of the spine. Then a hinge is created on the opposite side of the **spinous process** and the lamina is carefully lifted open on the cut side. This creates more room for the spinal cord and relieves the pressure while preserving the bone and ligament structure and avoiding the need for a fusion. In the opening, the surgeon will place a titanium plate to stabilize the spine. The Medtronic Sofamor Danek CENTERPIECE™ Plate Fixation System is intended for use in the lower cervical and upper thoracic spine (C3-T3) in laminoplasty procedures. The CENTERPIECE™ Plate Fixation System is used to hold the graft material in place in order to prevent the graft material from expulsion, or impinging the spinal cord. There are potential risks associated with the use of these devices some of which include: breakage of any or all of the components, loss of neurological function, appearance of radiculopathy, and/or **dural** tears.

## Medtronic solutions include:

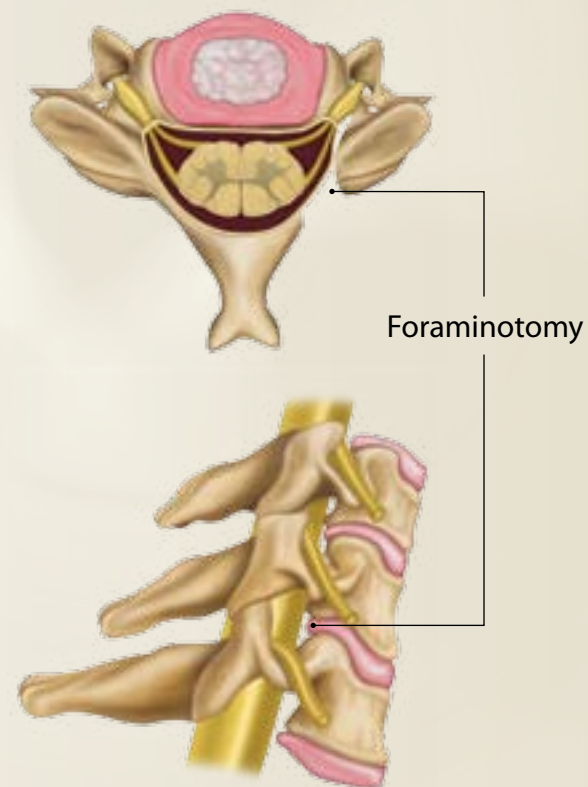
- » CENTERPIECE™ Plate Fixation System



This therapy is not for everyone. Please consult your physician. A prescription is required. For further information about our products, please call Medtronic at (800) 933-2635 and/or go to [www.medtronic.com](http://www.medtronic.com).

# Posterior Cervical Foraminotomy

This procedure enlarges the space around the nerve root where it exits the spinal cord. Disc material can also be removed in order to relieve compression. In this procedure there are no implants attached to the spine.



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# Glossary

**Cervical** — Of or relating to the neck.

**Degeneration** — The spine is made up of bones, or vertebra, and softer, gel-like discs. As the body ages, the discs in the spine dehydrate, or dry out, and lose their ability to act as shock absorbers. The bones and ligaments that make up the spine also become less pliable, and they thicken. As this progressive deterioration of tissue happens the discs began to pinch and put pressure on the nearby nerve roots or spinal cord. Disc degeneration is one of the most common disorders in the lower spine.

**Degenerative Disc Disease** — Discs are the pillow-like cushions between your vertebrae in your spine. They help your back carry weight and allow complex motions of the spine while maintaining stability. As you age, the discs can lose flexibility, elasticity, and shock absorbing characteristics. They also become thinner as they dehydrate. When all that happens, the discs change from a supple state that allows fluid movement to a stiff and rigid state that restricts your movement and causes pain.

**Discectomy** — Surgical removal of part or all of an intervertebral disc material placing pressure on neural elements.

**Dura** — A tough, fibrous membrane forming the outer covering of the spinal cord that does not adhere to the vertebrae.

**Facet** — A flat, plate like surface that acts as part of a joint; as seen in the vertebrae of the spine and in the subtalar joint of the ankle. Each vertebra has two superior and two inferior facets.

**Fusion** — Union or healing of bone.

**Foraminotomy** — Surgical opening or enlargement of the bony opening traversed by a nerve root as it leaves the spinal canal. A procedure carried out alone or in conjunction with disc surgery.

**Herniated Disc** — The disc, which is located between the bones of the spine (vertebrae), can split or rupture. When this happens, the inner gel-like substance (nucleus pulposus) leaks out.

**Intervertebral Disc** — Cartilaginous cushion found between the vertebrae of the spinal column. It may bulge beyond the vertebral body and compress the nearby nerve root, causing pain. The terms “slipped disc,” “ruptured disc,” and “herniated disc” are often used interchangeably even though there are subtle differences.

**Kyphosis** – The outward curvature of the upper lumbar spine causing a bowing of the back, which leads to a hunchback or slouching posture.

**Laminae** — The flattened or arched part of the vertebral arch, forming the roof of the spinal canal. The posterior part of the spinal ring that covers the spinal cord or nerves.

**Laminectomy** — Excision of one or more laminae of the vertebrae. Removal of the lamina, the bony element covering the posterior portion of the spinal canal.

**Lordosis** – The inward curvature of the cervical or lumbar segments of the spine. If the curvature of the spine becomes too great then stress is placed on other parts of the spine causing pain.

**Pedicle** — The part of each side of the neural arch of a vertebra. It connects the lamina with the vertebral body. The first portion of the posterior spine arising from the vertebral body.

**Pseudoarthrosis** — When a fusion does not form.

**Radicular** — Pain in the extremities such as the arms and legs.

**Spinous Process** — The portion of the vertebrae that protrudes posteriorly from the spinal column. The spinous processes create the “bumps” felt on the midline of the back. The most posterior extension of the spine arising from the laminae.

**Upper thoracic** — The first 7 of the 12 total thoracic vertebrae. The thoracic vertebrae compose the middle segment of the vertebral column, between the cervical vertebrae and the lumbar vertebrae. They are intermediate in size between those of the cervical and lumbar regions; they increase in size as one proceeds down the spine, the upper vertebrae being much smaller than those in the lower part of the region. While the neck and lower back are designed to provide us with mobility, the thoracic spine is designed to be very strong and stable to allow us to stand upright and to protect the vital internal organs in the chest. They are distinguished by the presence of facets on the sides of the bodies for articulation with the heads of the ribs, and facets on the transverse processes of all, except the eleventh and twelfth, for articulation with the tubercles of the ribs.

**Vertebrae** — One of the 33 bones of the spinal column.

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**Medtronic**

Spinal and Biologics Business  
Worldwide Headquarters

2600 Sofamor Danek Drive  
Memphis, TN 38132

1800 Pyramid Place  
Memphis, TN 38132

(901) 396-3133  
(800) 876-3133

Customer Service: (800) 933-2635

For more information go to  
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Please see package insert for a complete list of indications, warnings, precautions, and other important medical information.

It is important that you discuss the potential risks, complications, and benefits of these treatments with your doctor prior to receiving treatment and that you rely on your physician's judgment. Only your doctor can determine whether you are a suitable candidate for spinal surgery.