

# Thoracic and Lumbar Spinal Fusion Surgery Guide

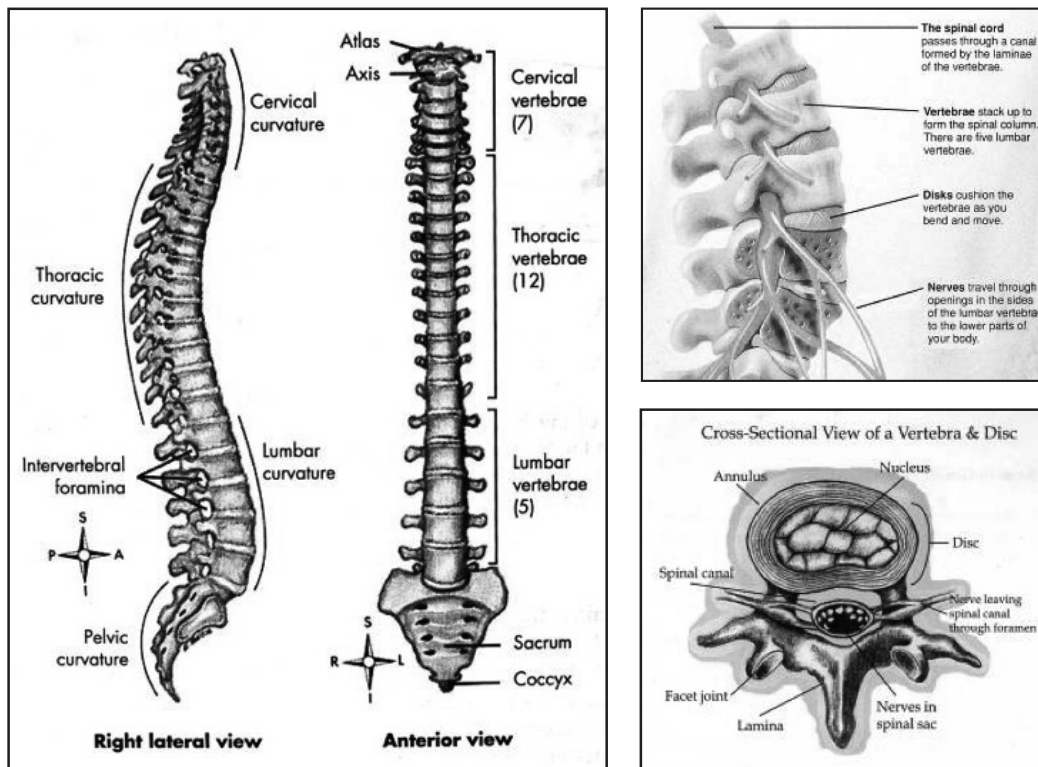
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## The Spine

Your spine is made of 26 bones known as vertebrae (7 cervical, 12 thoracic, 5 lumbar, the sacrum and coccyx). Each vertebra is separated by a disc (except the top two neck vertebrae). Each disc has a soft, jelly-like center surrounded by a tough outer layer of fibers known as the annulus. Discs, bony structures, ligaments and strong muscles stabilize the spine.

The spinal cord, which is the nerve center of the body, connects the brain to the rest of the body, and passes through the bony spine and usually ends at approximately L1 or L2. Beyond that, nerve roots are present in a fluid-filled tube. The outer layer of this tube is called the dura. At each segment, nerve roots exit/enter the spinal canal on each side (left and right). Nerve roots come from the spinal cord and carry electrical impulses to and from muscles, organs and other structures.



Compression or squeezing on the nerves in the spinal cord or nerve roots may be causing many of the different types of symptoms you may be experiencing. These symptoms may include back pain, leg pain, weakness in the legs or numbness in the legs. Other more serious symptoms include problems with bowel or bladder function.

## Spine Surgery

You are going to have spine surgery in the form of a spinal fusion. This is a decision reached by you and Dr. O'Neill after careful consideration. A spinal fusion entails the uniting or "welding" of the spinal vertebrae with spinal instrumentation.



1. **Incision:** The incision will be made in a vertical fashion in the center of your back. The length of the incision depends on how many levels need to be treated.
2. **Blood Loss:** The amount of blood loss expected will depend on the number of levels that need to be fused and what additional surgical steps might be needed (osteotomies, anterior fusions, etc). It is sometimes necessary to give blood transfusions either during or after surgery. If you have objections to receiving blood products, please let us know.
3. **Instrumentation:** Dr. O'Neill will put in rods, screws, hooks and/or wires (normally just rods and screws) to stabilize the affected area while the bone graft is healing or fusing. The screws are generally made of titanium and the rods are made of either titanium or cobalt-chrome.
4. **Bone Graft:** Your own bone obtained from your spine will **always** be used for the fusion, while cadaver (Allograft) bone is often also used. A genetically engineered protein (BMP) may also be used to obtain a fusion. The use of BMP will be discussed with you if Dr. O'Neill feels this would be beneficial in your case. Dr. O'Neill will choose the best instrumentation and fusion procedure for your individual needs.
5. **Spinal Cord Monitoring:** Spinal cord monitoring is a procedure that may be performed by a nurse during the surgery. Electrodes are placed on the scalp and other parts of the body to make sure that the spinal nerves have good blood flow. You may or may not notice some irritation to your scalp after the surgery. This irritation should resolve within a few days after the surgery.

6. **Expected Pain:** Though Dr. O'Neill will use as minimally invasive of a procedure as possible, back surgery can be painful. Every movement that you make will be transmitted to the muscles in your back. Often, patients will note additional painful areas distant to their back that are most likely related to being in a strange position for an extended period. Fortunately, these pains will eventually subside. The worst pain typically lasts for two to four weeks. Thereafter, the pain gradually begins to decrease, but may still persist for at least three to six months.
7. **Risks and Complications:** Certainly there are risks associated with any surgery. Dr. O'Neill would not recommend this procedure for you unless the expected benefits far outweigh the risks. We tell you about these risks not to scare you, but to make sure you have all the information you need to make an informed decision. Keep in mind that for all risks, steps are taken to minimize and/or prevent them from occurring.
  - **Minor Risks:** Some risks/complications are minor and can be easily treated. Consider these a "bump in the road" but nothing that will affect your ultimate recovery. We can't list, nor can we predict every possible thing that may happen. The following are some of the more common minor complications that may occur:
    - Muscle soreness/painful pressure areas (especially in the chest area)
    - Skin numbness on the back near the incision
    - Superficial wound infection
    - Bladder infection
    - Excessive pain
    - Constipation
    - Ileus (temporary slowing of bowel function)
    - Transient nerve irritation (pain/numbness/weakness)
    - Blood clot in your leg
    - Spinal fluid leak/dural tear
    - Post-operative pulmonary problems
    - Post-operative confusion/dementia from anesthesia/narcotics
  - **Major Risks:** Other more significant complications are very rare but still need to be mentioned. Some of the major risks of spine surgery are:
    - Neurologic deficit, up to and including paralysis
    - Pulmonary embolism (blood clot to your lungs)
    - Deep wound infection necessitating surgery/IV antibiotics
    - Pseudarthrosis (non-union of the bone) or instrumentation breakage/pullout
    - Major vessel injury and bleeding
  - **Major Medical Problems:** Stroke, heart attack, etc. up to and including death cannot be predicted
8. **Anesthesia:** You will have general anesthesia for your surgery. Anesthesia risks include throat discomfort; injury to teeth, dental work, eyes (including blindness) and vocal cords (which may affect your ability to speak); headache, backache, nerve damage, awareness under anesthesia, allergic reactions, stroke and heart attack. The anesthesiologist will discuss this with you in more detail during your pre-operative appointment.

## Before Surgery

Before your operation it may be necessary to have blood tests, a chest X-ray and/or an EKG performed to evaluate your general condition before undergoing anesthesia. If needed, all of these tests will be scheduled for you and will be done during pre-testing when you meet with the anesthesia staff. Sometimes a pulmonary evaluation is required. Most adults will need to have a medical evaluation by their internist prior to surgery.

1. **Exercise:** The stronger and more fit you are prior to having surgery, the better you will do post-operatively. Suggested activities are walking, swimming and deep breathing exercises. Cardio and/or aerobic exercises are also helpful if approved by your medical doctor. This is very important and will really be advantageous in your recovery after surgery. You may want to work with a physical therapist or personal trainer to optimize your condition preoperatively.
2. **Dental Work:** Make arrangements to have your teeth cleaned prior to surgery as you will not be able to have dental work or cleanings for six months postoperatively.
3. **Home Preparation:** During the time prior to your admission, you can also be getting your home "ready." Remember, **no BLTs** (bending, lifting, twisting or stooping/squatting) are permitted during your recovery period. It is advisable to place frequently used objects at an easily obtainable height. For example, have dishes most often used in upper cabinets. Additional things to consider:
  - You cannot sleep on a mattress on the floor or on a free float waterbed.
  - Arrange your kitchen for convenience (frequently used items placed in easy to reach places). Consider your precautions.
  - Remove throw rugs.
  - Have a chair with armrests and a firm seat available (not too low).
  - Install adjustable height hand held shower head (optional).
  - Apply non-skid stickers/mat to bathtub/shower.
  - Be careful with pets (dogs, cats) as you won't want to trip over them leading to a possible fall.
  - Make arrangements prior to admission for someone to help with house cleaning, laundry and groceries.
  - Arrange for someone to pick you up from the hospital in a reasonable vehicle.
  - Arrange for someone to stay with you after you go home from the hospital until you are comfortable getting around. Length of time depends on the magnitude of surgery and your recovery. It's better to have too much help than not enough.
  - Arrange for someone to assist you with light to heavy household chores (cleaning, laundry, etc.)
  - Arrange for someone to do the grocery shopping.
  - Arrange for transportation for several weeks (you will not be able to drive until you are off narcotics).
4. **Packing:** Please leave all valuables at home. You will need to bring any personal toiletry items you feel you will need during your hospital stay (toothbrush, toothpaste, a comb, brush, deodorant, lotions, etc.). You may bring rubber-soled slippers and a robe for out-of-bed activities. Loose-fitting clothing with elastic waistbands are recommended after discharge as they are easier to put on and take off and you may have some post-operative swelling. Do not bring your home medications to take in the hospital as they will be provided by the hospital pharmacy. This includes narcotics. It is a good idea to bring a list of your medications and the dosages so they can be correctly ordered for you.
5. **Day Before Surgery:** Light meals are recommended the day prior to surgery. **Nothing to eat or drink after midnight the night before your surgery.** You can brush your teeth, just do not swallow any water.

## Medications to Stop Before Surgery

- **Aspirin and blood thinners** (Coumadin, Persantine, etc) need to be stopped two weeks prior to surgery. Talk to the ordering physician for instructions on stopping.
- **Non-steroidal anti-inflammatory (NSAID)** medications/arthritis medicines (such as Advil, Aleve, ibuprofen, Motrin, Clinoril, Indocin, Daypro, naprosyn, Celebrex, Vioxx, etc.) should be stopped two weeks before surgery.
- **Tylenol** products are okay to continue.

- Stop the following **herbs** at least two weeks before surgery: Chondroitin, Danshen, Feverfew, fish oil, garlic tablets, ginger tablets, Ginko, Ginsen, Quilinggao, Vitamin E, and Co Q10.
- **Bone strengthening medications** (Forteo, Fosamax, Reclast, etc) need to be stopped one week before surgery.
- **Insulin and Prednisone** have specific instructions that may need to be adjusted prior to your surgery. Please let the anesthesiology team know all medications you are on.
- Medications for **blood pressure, heart and breathing** may need to be taken with a small sip of water the morning of surgery. During your pre-operative anesthesia appointment, the anesthesia staff will let you know which of these medications, if any, you should take.

## On the Day of Surgery

On the day of the operation you will be asked to arrive approximately two hours prior to your operation. You will check in and then be taken to a waiting area. Approximately one hour before the operation you will be called to the holding area where you will meet the anesthesiologist. The anesthesia staff will then place catheters in your arms for the intravenous fluids and then will begin to medicate you. The scheduled time of your surgery is really just an approximation. Much depends on the when the last case finished. Sometimes we can be off by more than a few hours.

When you get to the operating room, you may not see Dr. O'Neill. The staff working with Dr. O'Neill will assist the anesthesiologists and you will be put under general anesthesia. It is usually about 60 to 90 minutes from the time that you enter the room until Dr. O'Neill makes the incision.

At the conclusion of the procedure, it usually takes 30 to 60 minutes to wake you up and put you on the hospital bed before you are taken to the recovery room. At the conclusion of the case, Dr. O'Neill will instruct one of the nurses in the operating room to call down to the waiting area. Your family will be notified that your surgery is finished.

## After Surgery

1. **Recovery:** Patients will be taken to the recovery room. After your stay in the recovery room, you will be transferred to the inpatient unit.
  - It is not uncommon for patients to have facial and body swelling. This is due to the fluids received during surgery and positioning during surgery. The facial swelling generally resolves in one to two days. Rarely patients may have a very swollen tongue for the first few days post-op as well.
  - You may have a cardiac monitor on to watch your heart rate and rhythm.
  - You may have oxygen to make breathing easier.
  - You will wear elastic, thigh-high stockings (TED hose) and/or inflatable plastic wraps (sequential pumps) on your legs. Both the TED hose and sequential pumps are used to help prevent blood clots.
  - You will have a Foley catheter. This is a tube that is placed into the bladder to drain urine. The catheter will be inserted after you are asleep in surgery. The Foley catheter will be removed once you are able to get out of bed fairly easily.
  - You will have one or more drains (Hemovacs) near your back, front and/or side incision(s). These drains collect excess bleeding and drainage from under the skin. This keeps your wound from swelling and helps the doctors estimate your blood loss.
  - Your diet will be advanced slowly. You will begin with ice chips and sips of water, then advance to a clear diet and then to a regular diet.



- Please remember that during your hospital stay you will have a list of “as needed medications” or “PRN” medications, as the medical staff refers to, that will always be available to you. These medications will be for symptoms such as muscle spasms, nausea, indigestion, pain and itching. **Please** speak to your nurse if you have any symptoms that are not being controlled so she can go over the “PRN” medication list with you.
  - An Incentive Spirometer (IS) is also used to help you measure how deeply you breathe. Make it a personal contest to continue to increase the number reached by the “rising ball” of the device, thus demonstrating improved lung function. Family members, please remind your loved one to use the IS frequently in the hospital.
  - You will almost always be asked to sit on the side of the bed and also to get out of bed to stand and/or sit in a chair on the first post-op day, and to start walking as soon as possible.
  - It is very common for the patient to report numbness around the incision(s) after surgery. This is expected with any skin incision and the area of numbness gradually shrinks with time but may take up to one to two years.
  - Some patients complain that their feet/legs/back “feel funny.” You may have various feelings or sensations that can’t be explained. Please make Dr. O’Neill aware of this. Sometimes this is due to compression of small nerves in your legs from positioning, which will resolve over time.
2. **Pain Management:**
- After your surgery, you will be on a variety of medicines to help keep you as comfortable as possible. Some of these medicines are taken by mouth and others are through your IV.
  - Sometimes, a special pump called a Patient-Controlled Analgesia pump or PCA, will administer your pain medicine. This pump is at your bedside and you will be able to control the pain medicine. Shortly after you wake up from your operation, the PCA pump will be hooked up for you to use. The medicine will go right into your IV line only when you want it to. This way you don’t have to call the nurse to get a shot. The PCA pump has a special button you push when you think you need more pain medicine. The button is only for your use, not to be pushed by the nurse or your family. We make sure your PCA is set up so you don’t give yourself too much medicine.
  - We will transition you over your hospital stay to using only medicines taken by mouth. These will be the medicines that you are given to go home with.
3. **Occupational and Physical Therapy:** Dr. O’Neill may have an occupational therapist and/or physical therapist see you while you are in the hospital help to determine if you will need any extra assistance at home.

## Post-operative Instructions

1. **Wound Care:**
- If your incision is not draining any fluid, keep your incision open to air. If there is some drainage, apply dry gauze and secure in place with tape. Change the dressing at least one time per day.
  - If you have steri-strips (tape strips), they should fall off by themselves. If after two weeks, they have not fallen off, you may remove the steri-strips.
  - Please **do not** put any ointments or antimicrobial solutions over the incision or steri-strips.
  - If you notice drainage, significant redness, swelling or increased pain at the incision site, please call the office.
2. **Showering:**
- If the incision is no longer draining fluid, you may take a shower after five days from your operation.
  - There is no need to cover the incision.

- You may use soap and water to clean the incision, then gently dry off the incision and leave it open to air.
  - Please make sure incision is completely dry after showering.
  - **Do not** take a bath or get into a pool for six weeks after surgery or until the incision is closed and well healed.
3. **Medications:**
- **Narcotics:** Depending on the surgery and the amount of pain you are having, Dr. O’Neill will prescribe pain medications for you. The most common medications are Percocet/Oxycodone, Norco/Hydrocodone, and Tylenol #3. If you need refills on these pain medications, please call five business days in advance to allow time to fill these medications. These cannot be “called in” and need to be given to you on a written script.
  - **Muscle relaxers**, such as Valium or Flexeril, may be given to you as well.
  - Avoid all **anti-inflammatory medications**, including aspirin, ibuprofen (Advil, Motrin), and naproxen (Aleve), as well as any other prescription anti-inflammatories. It has been shown that anti-inflammatories decrease bone healing. Do not resume these medications until Dr. O’Neill says that it is okay to do so, which is usually three months after your surgery.
  - You may take **Tylenol** at any time (no more than 4000 mg of Tylenol in 24 hours).
  - If you were taking **aspirin or blood thinners** for a medical condition, such as heart disease, Dr. O’Neill will instruct you on how to proceed. It is generally okay to resume these medications immediately following surgery.
  - **Bone Strengthening Medications:** Forteo may be resumed one week post-op. Fosamax and Reclast may be resumed at three months post-op.
  - **Bowel Regimen:**
    - You may be given a prescription for a stool softener/laxative combination (e.g. Senna-S)
    - If it has been three days since your last bowel movement, increase the Senna-S to two tablets twice a day (this is the maximum dose allowed).
    - If you do not have a bowel movement for five days, take Miralax as directed in addition to the Senna-S.
    - If you have not had a bowel movement for six days, take a suppository as directed on packaging.
    - If no bowel movement for seven days post-op use a Fleets Enema (dosing per package).
    - If this does not give you results, contact our office for further instructions.
    - If at any time you are nauseated, have vomiting, abdomen is swollen and hard and/or you have severe abdominal cramping, please contact our office immediately.
    - You may resume all of your other home medications, including vitamins and supplements.
4. **Toileting:** Low toilet seats can make regular toileting very difficult and unsafe for patients who have had back surgery. Depending on the type, location and surrounding area of your toilet, you may be instructed in using a raised toilet seat and/or toilet rails.
5. **Driving:** You may ride as a passenger whenever you feel you can tolerate this activity. You should sit in the front passenger seat, slightly reclined if possible. For longer trips, it is recommended that you stop every one to one and a half hours and get out of the car and walk in order to get your heart pumping and your blood circulating (this will prevent blood clots from forming). Driving is generally permitted approximately four to six weeks after surgery if you are off of the narcotics. You should not drive while taking strong pain medications.
6. **Recovery of Symptoms:** What to expect regarding your symptoms that were present prior to surgery depends on the cause of the problem:
- **Radiculopathy Resulting from Nerve Root Compression:** Radiating pain, numbness or tingling, or even weakness, may improve immediately after surgery. Occasionally symptoms may temporarily worsen after surgery as a result of nerve manipulation and resulting inflammation, but should resolve over the following few weeks of recovery. In general, the longer symptoms

were present before surgery, the longer it takes to recover. Recovery may continue to occur for several months after surgery. We won't know until one year after surgery which symptoms are permanent.

- **Myelopathy Resulting from Spinal Cord Compression:** Balance trouble, bowel or bladder dysfunction, lack of coordination, diffuse numbness of hands or feet, may also improve immediately after surgery. However, these symptoms may or may not improve at all. If recovery does occur, it may take several months of recovery. We won't know until one year after surgery which symptoms are permanent.
- **Back Pain:** The worst pain typically lasts for two to four weeks. Thereafter, the pain gradually begins to decrease, but may still persist for at least three to six months. All of this is normal during the healing process.

## 7. **Activities/Restrictions:**

- **Turning in Bed:** Tighten your stomach muscles. Bend your knees slightly toward your chest. Roll to one side, keeping your ears, shoulders and hips in line. Be careful not to bend or twist at the waist.
- **Getting Out of Bed:** Tighten your stomach muscles. Turn onto your side. Push your body up with one elbow and the other hand. At the same time, gently lower both legs to the floor. Keep your stomach muscles tight.
- **Sit Down/Stand Up:** Use your arms to lift up and guide down. Keep your ears, shoulders and hips in line. Brace your abdominal muscles, bend at the hips keeping your back straight and use your leg muscles to lower/raise yourself onto the front of the chair.
- **Standing and Turning:** If you stand for a long time, change your position frequently by shifting your weight from one foot to the other. **Don't twist.** Turn your whole body as a unit.
- **Bending and Lifting:** During the first six weeks, avoid bending or lifting anything weighing more than 20 pounds. When you lift something, keep it close to your body so that your leg and arm muscles do the work. Remember to brace your abdominal muscles, stoop at the hips and knees keeping your back straight and the three curves of your spine balanced. This will help prevent pain and further injury to your spine.
- **Sexual Relations:** Lying on your back so you have the support of the mattress is preferable. Side-lying positions may be more comfortable since you won't bear any weight. Avoid arching your back. Avoid a lot of back motion or stress on your spine.
- **Walking/Exercise:** Walking is **excellent** exercise. Walking helps your pulmonary, cardiovascular and digestive systems. It also prevents blood clots from forming and it increases muscle strength and endurance. Similarly, non-impact aerobic exercise is also recommended, such as stationary bikes or elliptical machines.
- **Stairs:** Your physical therapist will practice stairs with you before you go home. You should use a handrail when possible. Never use a walker on the stairs. Your therapist may have special instructions for you depending on your home environment and physical abilities.
- **Getting In and Out of The Car:** The car should be mid-size or larger. **Do not** attempt to get into the back seat of a compact car (two doors). The patient should sit in the front passenger seat slightly reclined and as far back as possible.
- **To Enter the Car:** Walk up to the passenger door, turn and back up until you feel the car behind your legs. Reach back and place your left hand on the dashboard or car door and place your right hand on the back of the front seat. Bend your legs and gently sit down. Scoot hips back and slowly turn your body as you put your legs inside the car.
- **To Exit the Car:** Gently turn your body while placing your legs outside the car. Scoot forward until your feet are on the ground. Push up to a standing position by placing your arms on the dashboard or car door and back of the seat.



8. **When to Call:** Please call any of the OrthoIndy offices if you have any questions or concerns. If it is not urgent, please call during normal business hours. Specific things that should prompt you to notify us include:
  - Fever higher than 101 degrees Fahrenheit
  - Severe headaches that are worse when sitting upright, relieved when laying down
  - Wound drainage that is not decreasing
  - Significant redness or swelling around the incision
  - Worsening numbness, tingling or weakness in your arms or legs
9. **Follow-up Appointment:** If a follow-up appointment has not been scheduled for you, please call **317.802.2049** to set up an appointment within a few days of your discharge.

## Glossary of Terms

**Anterior:** The front portion of the body. It is often used to indicate the position of one structure relative to another.

**Bone Morphogenetic Protein (BMP):** A genetically engineered bone substitute (protein) that helps your bones fuse. Used in combination with your own bone. BMP is not yet FDA-approved for all types of surgery, but surgeons may use the medicine for whatever application they feel is appropriate for the patient. This is called using it "off-label." We are actively studying this medicine to see how effectively it works. Clearly all data and our experience shows that it is very safe. Currently BMP is FDA-approved for use in the anterior spine with cages. Use of the product posteriorly is "off-label."

**Bone Graft:** Bone, which is harvested from one location in an individual and placed in another individual (allograft bone) or in a different location in the same individual (autogenous bone).

**Cervical Spine:** Seven spinal segments (C1-C7) between the base of the skull (occiput) and the thoracic spine.

**Coccyx:** The region of the spine below the sacrum, also known as the tailbone.

**Decompression:** This procedure is carried out to relieve pressure on the spinal cord or nerve roots. The pressure may result from fracture fragments, disc fragments, bone spurs, tumors or infections.

**Decompression Laminectomy:** A posterior approach decompression done by removing the lamina and spinous process.

**Disc Degeneration:** The loss of the fluid content, structure and functional integrity of the disc.

**Discectomy:** The excision of the intervertebral disc material that may be described as herniated, implying "bulging" or "ruptured" through the ligaments. If the central fragment of disc material has torn through a hole in the ligament, it is called an extruded fragment or extruded disc. The term herniated nucleus pulposus (HNP) is a catchall phrase for all of these conditions.

**Facet:** A posterior structure of a vertebra which articulates with a facet of an adjacent vertebra to form a facet joint that allows motion in the spinal column. Each vertebra has two superior and two inferior facets.

**Foramen:** An opening allowing for the emerging of spinal nerve roots between two vertebrae.

**Foraminotomy:** A procedure carried out in conjunction with disc surgery. The foramen (openings for the individual nerve roots to pass from the spine) may become narrowed because of disc impingement, intervertebral collapse, and spondylolisthesis. The surgical widening of the foramen is an attempt to relieve the pressure on the nerve roots.

**Fusion:** The uniting of two bony segments together to remove motion, relieve pain and prevent deformity progression.

**Iliac Bone:** A part of the pelvic bone that is above the hip joint. Using iliac bone graft is not commonly done anymore.

**Internal Fixation:** The immobilization of bone fragments or joints with implants (metal screws, rods, etc.) in order to promote healing or fusion.

**Interspinal or Intervertebral Disc:** The structure that normally occupies the space between two moving vertebrae. It is more prominent in the cervical and lumbar spines. It is much like a radial tire. The centermost portion of the disc (nucleus pulposus) is normally composed of a clear gelatinous material that varies in consistency from a firm jelly material to a very thick and less pliable substance. This core is then surrounded by numerous layers of fibrous (fibrocartilaginous) material called the annulus fibrosus. That structure goes to the normal margins of the vertebral body. There is a thick ligament (approximately 2 mm) that covers the anterior part of the vertebral body called the anterior longitudinal ligament, and on the spinal canal side posteriorly is the posterior longitudinal ligament.

**Kyphosis:** The normal forward curvature of the thoracic spine. The condition “kyphosis” refers to an abnormal increase in this forward curvature.

**Lamina:** An anatomical portion of a vertebra. For each vertebra, two lamina connect the pedicles to the spinous process as part of the neural arch.

**Laminectomy:** An operation for removal of part or all of the lamina of a vertebra commonly performed in order to be able to remove an intervertebral disc protrusion or to decompress a nerve root.

**Lordosis:** The normal mild “swayback” curve of the lumbar spine.

**Lumbar Spine:** Five mobile segments of the lower back (L1 to L5). These are the largest of the vertebral segments and provide most of the bending and turning ability of the back, in addition to bearing most of the weight of the body.

**Nerve Root:** The portion of a spinal nerve in close proximity to its origin from the spinal cord.

**Pedicle:** The part of each side of the neural arch of a vertebra. It connects the lamina with the vertebral body.

**Posterior:** Located behind a structure, such as relating to the back side of the body.

**Pseudarthrosis:** an area of the spinal fusion where the bone did not heal (fuse). Often found with broken instrumentation and, in some instances increased pain, although not always.

**Sacral Spine (Sacrum):** The five fused segments of the lower spine that connect to the pelvis and have four foramen on each side.

**Sciatica:** A lay term indicating pain along the course of a sciatic nerve, especially noted in the back of the thigh and below the knee.

**Spinal Canal:** The long canal between the vertebral bodies anteriorly and the lamina and spinous processes posteriorly through which the spinal cord passes. The spinal cord and nerve roots extend to the level of the second lumbar segment in adults. Below this level are numerous nerve roots from the spinal cord that resemble a horse's tail and is referred to as such (cauda equina). The thick outer covering of the spinal cord is called the dura.

**Spinal Fusion:** A surgical procedure to permanently join bone by interconnecting two or more vertebrae in order to prevent motion.

**Spinal Stenosis:** Reduction in the diameter of the spinal canal due to arthritic overgrowth of bone and soft tissue, which may result in pressure on the spinal cord or nerve roots.

**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.

**Spondylolisthesis:** A defect in the construct of bone between the superior and inferior facets with varying degrees of displacement so the vertebra with the defect and the spine above that vertebra are displaced forward in relationship to the vertebrae below. It is usually due to a developmental defect or the result of a fracture.

**Spondylolysis (also referred to as a stress fracture or a pars fracture):** Fracture of a posterior portion of the vertebra. A defect in the neural arch between the superior and inferior facets of vertebrae without separation at the defect and therefore no displacement of the vertebrae. It may be unilateral or bilateral and is usually due to a developmental defect but may be secondary to a fracture.

**Thoracic (dorsal) Spine:** Twelve spinal segments (T1-T12) incorporating the 12 ribs of the thorax. Other than a slight increase in size from top to bottom, they are fairly uniform in appearance.

**Transforaminal Lumbar Interbody Fusion (TLIF):** A way to do an anterior fusion (front of the spine) from a posterior approach. Usually performed in the lower lumbar spine (i.e. L4-5, L5-S1).

**Vertebra:** One of the bones of the spinal column. A cervical, thoracic, or lumbar vertebra has a cylindrically shaped body anteriorly and a neural arch posteriorly (composed primarily of the laminae and pedicles as well as the other structures in the posterior aspect of the vertebra) that protect the spinal cord. The plural of vertebra is vertebrae.