LUMBAR PEDICLE SCREW FUSION

CONTENT
INTRODUCTION
INDICATIONS
ALTERNATIVES
INFORMED REFUSAL
BEFORE
GOALS
TECHNIQUE
NO SMOKING
EXPECTATIONS
REHABILITATION
ON-GOING CARE
POTENTIAL COMPLICATIONS

INTRODUCTION
A spinal fusion is done to join two vertebrae together to make one large bone. The surgeon roughens up the external surfaces of the two vertebrae to make the body’s natural repair system think that one large bone has broken. The surgeon then adds bone to fill the gap. The body then joins the mass together, like a normal fracture. While the bone is healing, it is held still by screws and plates or rods. Full fusion takes three months. Bone chips can be taken from your hip at the time of the operation, and then grafted onto your vertebra. Alternatively, bone can be harvested from other patients and stored until needed in a bone bank. Using bone from the bone bank saves you the pain of this surgery, but doesn’t produce as high fusion rates as using your own bone. Artificial and natural bone substitutes are also available. New bone from the roughened vertebra migrates along the grafted bone to connect the area to be fused. Bone Morphogenetic Proteins may be used to accelerate the fusion rate.

INDICATIONS
A spinal fusion is performed when the spine is unstable, and can’t maintain the functional alignment between all of its important structures, or the abnormal movements cause pain and put adjacent structures at risk of injury.

Causes of spinal instability include degenerative joint disease, spondylolysis, fractures, infections and tumors.

ALTERNATIVES
The alternative treatments to lumbar fusion are weight loss
walking
pain-relieving medication
physical therapy
hydrotherapy
injections of steroid and local anesthetic around nerves or into the facet joints, and
lumbar disc replacement in very few cases
avoiding bending, lifting, twisting and prolonged sitting.

The use of lumbar bracing and acupuncture is controversial.

INFORMED REFUSAL
It is your right to delay or refuse the recommended treatment for your condition. However, this delay or refusal may lead to the worsening of your symptoms, such as increased leg pain, pins and needles, weakness or numbness.

BEFORE
Before the pedicle screw fusion
- a doctor will perform a medical examination and any necessary tests to ensure that your general health will permit an anesthetic to be given and the procedure to be performed
- you will be advised when to stop any medications that will increase your bleeding risk ie aspirin, non-steroidal anti-inflammatories, anti-coagulants, vitamin E, glucosamine and some herbal medicines
- you may be admitted into the hospital on the day before or on the morning of the procedure
- don't eat or drink anything for eight hours before the procedure
- wear loose-fitting clothes that are easy to take off and put on. Do not wear any jewelry.
- before the procedure, the skin on your neck will be cleaned and you will be given a general health check.
- an intra-venous line will be placed in to a vein in your arm to administer fluid and medications
- you may be given a sedating medication to make you drowsy before being given your anesthetic
- you will be given a general anesthetic that will put you to sleep
- let your doctor know if you develop a fever, cold or flu symptoms before your scheduled procedure.

GOALS
The pedicle screw fusion replaces the damaged, painful facet joints with solid bone and the laminectomy gives the compressed spinal cord and nerves more room.
**TECHNIQUE**

You will be placed in a kneeling position. Your skin will be cleaned. An incision will be made in the middle of the back. The overlying muscles will be moved to the sides. The spinous processes will be removed. The ligamentum flavum is then separated from the lamina. The lamina is removed at each level needing to be decompressed. The remaining ligamentum flavum are removed. The tracks for the pedicle screws are prepared. The vertebra surface is roughened. The bone graft is laid. The remaining pedicle screws, brackets and rods are installed. The muscles are replaced, and the wound is closed with sutures.

**NO SMOKING**

Smoking damages every part of your body and decreases the chance of a successful procedure. If you smoke, you should stop now.

**EXPECTATIONS**

Because there are so many reasons for having a lumbar fusion, the success rate varies widely. Your surgeon will discuss your case with you. With cancer and fractures there is often no alternative to having a fusion. In degenerative joint disease, surgery is always optional.

**REHABILITATION**

Your rehabilitation will require the following

The operation takes four to eight hours. Some patients spend the first one to two nights in an Intensive Care Unit, and a total of five to ten days in hospital. An epidural anesthesia can be used to prevent pain for the first twenty-four hours. After that, Patient Controlled Analgesia, which the patient controls with a hand-held button, is available. A bladder catheter is used for the first few days. On the second or third day, standing and walking is commenced with assistance. Your surgeon may recommend that a lumbar brace be worn every-time you are out of bed for the first three months. The physical therapist will show you how to get out of bed and undertake your daily activities.

After discharge, you should limit your exercise to just walking for the first six to twelve weeks. You must avoid all bending, lifting, twisting and prolonged sitting. Bending and lifting especially should be avoided, as they can break the screws and cause non-fusion to occur. If you are given a brace to wear after the operation, it should be worn whenever you are out of bed. However, you won’t need to wear it while you are sleeping, or to go to the bathroom in the middle of the night.
Check your wound twice a day. If you notice any redness, swelling, green or yellow discharge, or opening of the wound, see your family doctor immediately. You should keep the wound dry. Showering is permitted, but avoid baths, swimming and creams for one week. It is safest to use a shower chair for the first week. The incisions should be cleaned gently using regular soap and water. Only rub gently and don’t use perfumed soaps.

You should have your wound reviewed by your family doctor one week after the surgery.

If your incision has staples or sutures that need to be removed, they can be removed after two or three weeks by your nurse or local doctor.

You should not drive for two or three weeks. You can be a vehicle passenger for up to thirty minutes, no longer. If you must travel for a longer period, have several stops so that you can stretch your legs. Reclining the passenger seat will provide you with the greatest comfort during travel.

Do not sit for longer than thirty minutes. You may increase this time as you become more comfortable.

Walk as much as possible. Stairs are good, but climb them slowly. You can use a treadmill, but avoid running. If you were discharged from hospital with a walker or cane, you may stop using it once you feel safe and comfortable.

A follow-up appointment with your surgeon will be booked for six weeks after the surgery. Repeat spine X-rays are usually taken at six weeks, three and six months, and one and two years.

ON-GOING CARE

You have a weak spot in your back, and surgery can never return it to full strength. You will need to engage in lifelong back care to reduce the risk of further neck problems. You should always maintain correct posture, lose any excess body fat, continue your daily exercise program and avoid unnecessary stresses on your back.

POTENTIAL COMPLICATIONS OF A LUMBAR PEDICLE SCREW FUSION

ALLERGIC REACTION TO MEDICATION

An allergic reaction to the medications used can occur. This can cause a rash, swelling of the eyelids, hands, joints and throat, difficulty breathing, low blood pressure and death. These reactions are easily controlled with the right equipment and medications.

ADJACENT SEGMENT SYNDROME

When one area of the spine has been fused and no longer allows any movement there, it transfers increased stress to the adjacent segments. This can increase wear and tear in these adjacent intervertebral discs, facet joints,
pars articularis and ligamentum flava, and can lead to increased mobility and pain. These changes are called adjacent segment syndrome or transitional syndrome. Adjacent segment syndrome is more likely with instrumented fusion (pedicle screws, rods), multiple segments fused, abnormal fusion alignment, facet joint injury during surgery, age, and pre-existing degenerative changes. Adjacent segment syndrome can be seen in up to 100% of x-rays after ten years, although it often does not cause symptoms. Only symptomatic adjacent segment disease requires treatment. Some twenty percent of fusion patients will eventually need another operation to treat the adjacent segment degeneration symptoms by nerve decompression and extension of the fusion. Some pre-existing degenerative disease in the adjacent segments can be expected as part of the initial disease process, and this may require treatment as part of its natural progression, or it can accelerate the development of adjacent segment disease.

BACK PAIN
Back pain after the procedure is to be expected. This may be similar or different to the original back pain. It is usually temporary. Sometimes the original back pain can persist, or it can be worse.

BONE GRAFT DISPLACEMENT
During a bone graft, fragments of bone are placed in the space between two bones. If the space is kept still, the bone fragments will fuse together and to the adjacent bone to form one solid, stable, pain-free piece of bone. However, if excess movement occurs between the adjacent bones before the bone fragments have fused, the bone graft can become displaced. This can cause or risk causing pain, injury to adjacent tissues, mal-alignment (of bones) or non-fusion of bone (non-union, pseudoarthrosis). This may require another operation to correct.

BONE GRAFT MISPLACEMENT
During a bone graft, fragments of bone are placed in the space between two bones. If the space is kept still, the bone fragments will fuse together and to the adjacent bone to form one solid, stable, pain-free piece of bone. Your surgical team uses all available equipment and techniques to ensure the bone grafts are placed in the best possible position. Rarely, because of anatomical variations, equipment limitations or system failures, the implants are not optimally placed, and a further procedure may be required depending upon the results of the initial procedure.
BONE MORPHOGENETIC PROTEINS
Bone morphogenetic proteins (BMP) are a group of naturally occurring proteins that have been shown to attract bone-forming cells, and to stimulate cells to form bone, a process called osteo-induction. They can be made in the laboratory using genetic engineering, and are then called recombinant bone morphogenetic protein. BMPs can be placed at the fusion site in spine surgery and avoid the need for bone graft. BMPs are
- expensive when compared to using bone graft, but they
- decrease the time for fusion by one third,
- increase the rate of successful fusion from 70 to 80% up to over 90%,
- avoid the pain, blood loss and risk of infection and nerve damage of bone graft harvesting from the client,
- avoid the risk of infection from using bone graft from another person, and
- lead to a quicker discharge from hospital and more rapid return to normal activities.

Potential risks of the use of bone morphogenetic proteins are
- bone growth in unwanted areas such as the wound leading to the fusion site or the adjacent epidural space or inter-vertebral foramina
- transient resorption of adjacent bone
- seroma formation or local edema
- local inflammatory reaction
- the unknown effects on a developing embryo during pregnancy
- potential development of an immune reaction to the BMP, especially if used in subsequent surgeries.

CAUDA EQUINA SYNDROME
The cauda equina is the bundle of nerves below the spinal cord in the spinal canal. They transmit movement and sensation information to and from the lower body and also manage the bladder, bowels and sexual function. Cauda equina syndrome occurs when pressure is applied to these nerves, and they are inhibited. If the pressure is not removed quickly, permanent nerve damage can occur. Cauda equina syndrome can cause leg paralysis and numbness, impaired bladder or bowel control, loss of sexual sensation and other problems. The pressure on the nerves can be due to damaged disc or bone, tumour, infection or bleeding. The longer and more severe the compression, the longer and less likely the recovery. Severe compression greater than 24 hours may never recover. Milder compression may take several years to recover. Post-
operative cauda equina syndrome is usually due to an epidural haematoma, and requires an urgent procedure to remove the collection of blood.

CEREBROSPINAL FISTULA
A tear in the dura, which contains the spinal cord and the cerebrospinal fluid, can allow cerebrospinal fluid to leak out through the wound, and onto the skin. This is called a cerebrospinal fistula. It may cause headache when standing, back or limb pain, nausea, vomiting, dizziness, ringing in the ears or eye pain from bright light. There is a risk of infection and meningitis. The dural tear may reseal spontaneously, or it may require bed rest, a blood patch procedure, drainage, or surgery to repair.

DEATH
No surgeon can guarantee a risk-free operation. All operations have some risks. Some risks are minor inconveniences, while some are major disabilities. The risks increase with repeat operations on the same area of your body. Your entire medical staff will do their best to eliminate all risks to you, before, during and after your surgery. However sometimes, even after the surgery goes well, serious problems can arise that can result in death. These include pneumonia, pulmonary emboli, heart attack and stroke. You should discuss these risks with your Surgeon and your Anesthesiologist.

DEEP VEIN THROMBOSIS
A blood clot that forms inside the large deep veins of the legs is called a deep vein thrombosis, or DVT. Any surgery can put you at an increased risk of deep vein thrombosis because the blood’s clotting mechanism is switched on by the body trying to stop the bleeding associated with the operation. As well, injury to blood vessels, immobility and anesthetic effects during and after the surgery make it easier for clots to form and grow. Also some people have additional DVT risks such as age greater than fifty years, varicose veins, previous heart attack, cancer, atrial fibrillation, ischemic stroke, diabetes, previous DVT, heart failure, combined oral contraceptive pill use, smoking, obesity, leg weakness, and inherited clotting abnormalities. You should tell your doctor if you think you have any clotting problems.
A DVT can cause two problems. It blocks the blood flow from the legs back to the heart, causing swelling of the legs and pain. If the clot doesn’t dissolve properly, the swelling and discomfort can become permanent. Secondly, and more seriously, a part of the clot in the leg can
break off and travel up the veins to the lungs, where it blocks the smaller lung blood vessels and stops the blood flow. This is called a pulmonary embolus, or PE. If the PE is large enough or there are many of them, it can cause death. It is important to minimize your risk of deep vein thrombosis and pulmonary embolism. Two preventative techniques are used. The first applies mechanical means to increase the blood flow through the legs, and includes support stockings, sequential compression devices, leg exercises in bed, and getting out of bed as soon as possible. The second technique uses chemical means to slow down the blood’s clotting process. These include heparin and coumadin. However medications that thin the blood to prevent clotting will also increase the risk of bleeding and hematoma formation. Your doctor will discuss the use of these medications with you. It is normal to use some method to minimize clot formation during and immediately after spinal surgery.

**DISCITIS**

Discitis is an infection of the intervertebral disc. It can occur spontaneously, without any surgical procedure. Post-operative discitis can occur up to six weeks after a disc operation or injection, and most commonly causes worsening pain after an initial period of relief. Risk factors include age, smoking, obesity, diabetes, malignancy, chemotherapy, immune suppression, malnutrition, indwelling venous catheters, concurrent infections and extended hospitalization. Discitis is treated with antibiotics. Often a prolonged (months) course of antibiotics is required. Discitis with infection of the adjacent bone, or osteomyelitis, can be very difficult to cure, even with antibiotics. Discitis can lead to an epidural abscess that can cause spinal cord compression or cauda equina syndrome, and may require an operation to cure.

**DUROTOMY**

The dura is a thin layer of tissue that forms a sac containing the brain, spinal cord and nerve roots. The sac is filled with cerebrospinal fluid or CSF. The dura can be torn during spinal surgery leading to a leak of the fluid from the sac. This complication is more difficult to avoid during repeat surgery at the same location, or when operating on severe spinal narrowing or a large disc herniation. A dural tear with the leakage of cerebrospinal fluid, can cause a headache when standing, back or limb pain, nausea, vomiting, dizziness, ringing in the ears or eye pain from bright light. A continuing leak can lead to a cerebrospinal fluid cyst under the
skin, or a leakage of fluid from the wound. Dural tears can reseal spontaneously, or it may require bed rest, a blood patch procedure, drainage, or an additional operation to repair.

**DYSESTHETIC LEG PAIN**
Sometimes a burning hypersensitivity leg pain occurs after the procedure. This is called dysesthetic pain. This pain may resolve over a few days, but can be permanent. The cause is not clear.

**EPIDURAL HEMATOMA**
If bleeding occurs into the epidural space around the spinal cord, it may form a collection of blood, called an epidural hematoma. If the hematoma is large, it can compress the spinal cord and nerve roots leading to pain, weakness, numbness and bowel and bladder problems. A surgical procedure may be required to stop the bleeding and remove the hematoma.

**EYE INJURY**
During the general anesthesia, all care is taken to protect your eyes. They will be taped closed to reduce the risk of drying or scratching the surface of the eye. Should this happen, it usually heals over a day or two. A more serious, and much more rare complication is blindness from pressure on the eyeball or decreased blood flow through the eye, known as ischemic optic neuropathy. Blindness due to ION is a 0.1% risk, and is associated with emboli, prolonged spine surgery in patients greater than seventy years old, prone (face down) position, diabetes, intra-operative blood loss/hypotension, and ankylosing spondylitis (poor position because of neck deformity). Your Anesthesiologist will do all they can to eliminate risk of these problems.

**HEMATOMA**
During any surgery, some blood vessels will be cut. Your surgeon will stop all significant bleeding before suturing the wound shut. Sometimes bleeding recommences after the operation, forming a collection of blood in the tissues, called a hematoma. The hematoma can cause pain, pressure on adjacent tissues or become infected. It may need to be removed by inserting a drainage tube or performing a surgical operation.

**HEMORRHAGE**
During surgery, blood vessels must be cut to access the desired location in your spine. Your surgeon will plan the surgical route to avoid large blood vessels, and will ensure bleeding has stopped before finishing the
operation. Sometimes, one of these cut blood vessels begins re-bleeding after the operation. If the amount or location of the bleeding is causing you a problem, your surgeon may need to perform a further procedure to stop the bleeding and remove the accumulated blood.

**ILEUS**
Post-operative ileus refers to temporary paralysis of the bowel, usually caused by intra-abdominal, spine or chest surgery and narcotic pain-killing medications. Symptoms include abdominal discomfort and bloating, constipation, nausea or vomiting. Most cases settle within three days by fasting and minimizing the use of narcotic medication. Occasionally, emptying of the stomach by naso-gastric suction tubes and intravenous feeding and fluid is required.

**IMPLANT FAILURE**
Spinal fusion operations use screws, plates, rods and spacers to hold the vertebrae in correct alignment while the bone fuses together over the first few months. Once the bone fuses, these implants are not necessary. They are left in place if they are not causing any problems because of the surgical risks involved in removing them. Sometimes, before the bone has fused, an implant may break or migrate from its correct position. This can cause or risk causing pain, injury to adjacent tissues, mal-alignment (of bones) or non-fusion of bone (non-union, pseudoarthrosis) and may require a second operation to remove or replace the implant.

**IMPLANT MISPLACEMENT**
Spinal fusion operations use screws, plates, rods and spacers to hold the vertebrae in correct alignment while the bone fuses together over the first few months. Your surgical team uses all available equipment and techniques to ensure the implants are placed in the best possible position. Rarely, because of anatomical variations, equipment limitations or system failures, the implants are not optimally placed, and a further procedure may be required depending upon the results of the initial procedure.

**INFECTION**
Infections occur in less than one percent of spinal operations. If the wound becomes more painful or tender, red, hot or swollen, oozes a clear or yellow fluid and doesn’t heal, or if you have fever or chills, the wound may be infected. Your Surgical Team will use sterile instruments, aseptic techniques, antibiotics and regular wound care to minimize this risk. Infections can be:
superficial, involving the skin. These infections usually respond to oral antibiotics and washing the site. Sometimes the wound needs cleaning and re-suturing in the operating theatre.

deep, involving the vertebrae or spinal cord. This is more serious and may require intravenous antibiotics, and further operations to drain the infection. Rarely, infected bone graft or hardware may need to be removed. Wound infections are more likely if you smoke, have diabetes, are overweight, or if the wound took a while to heal or there was a hematoma.
If you have any concerns, you should contact your doctor immediately.

MALIGNANT HYPERThERMIA
Malignant hyperthermia is a rare life-threatening condition that is triggered in genetically-predisposed people by some drugs used for general anesthesia. In susceptible people, the drugs cause an uncontrolled increase in skeletal muscle calcium levels and muscle contraction, leading to decreased blood oxygen and increased blood carbon dioxide and body temperature. This can lead to circulatory collapse and death if not quickly treated. Susceptible people may have multiple episodes of anesthesia without developing malignant hyperthermia. Symptoms usually develop within one hour of drug administration. There is no simple test to diagnose susceptibility to malignant hyperthermia. It is usually found during drug administration or suspected if a family member develops the symptoms. While treatment is effective, if you or a family member have experienced malignant hyperthermia, you must avoid the potential trigger drugs. There are safe alternative medications available.

NERVE INJURY – LATERAL FEMORAL CUTANEOUS
The lateral femoral cutaneous nerve supplies sensation to the front of the thigh. It usually passes under the inguinal ligament in front of the hip, however in 10% of people it passes over the anterior iliac crest. near the site of bone graft removal. It can be injured during bone graft removal or by prolonged pressure while lying on your front during the surgery. Injury causes pain, pins and needles or numbness on the front of the thigh, called meralgia paresthetica. Pressure injuries usually resolve within three months. If the nerve has been cut, the symptoms may be permanent. Anesthetic injections can help with pain management. Occasionally surgery may be required.

NERVE INJURY – LUMBAR
Because the vertebrae surround the spinal nerve roots, operations on the vertebrae can injure the nerve roots within the spinal canal or as they leave the spinal canal through the intervertebral foramen. The nerves can be bruised, stretched, torn or cut while accessing or repairing the damaged vertebra. Locating, protecting and mobilizing the spinal nerves are the most difficult and time-consuming part of most spine surgeries. Your surgeon will be very careful to avoid any injury to the spinal nerves. If a nerve is damaged, the injury can cause temporary or permanent pain or bladder and bowel dysfunction as well as partial or complete loss of sensation or movement in your leg.

NERVE INJURY – ULNAR
While under anesthesia, your body will be immobilized in a certain position to allow access to the injured region, and to keep your arms out of the way. Sometimes the ulnar nerve in your arm can be inadvertently compressed or stretched at the elbow, leading to pain, numbness or weakness in the hand after the procedure. These symptoms can appear one to four days after the procedure, and usually disappear over a few weeks. Your medical and nursing staff will take all care to minimize risk of this complication.

NON-UNION
Failure of the two vertebrae to fuse into one solid bone is called non-union or pseudo-arthrosis. This occurs in about ten percent of spine fusion operations. Nicotine products, including chewing tobacco, and cigarette and cigar smoking, slow bone healing and significantly increase the likelihood of non-union. Consuming high doses of non-steroidal anti-inflammatory drugs after the operation can also increase the risk of non-union. Other causes are excessive alcohol intake, the location and number of segments fused, osteoporosis and some medical diseases. Non-union can cause worsening pain, and may cause the supporting hardware to break. Additional surgery may be required to add more bone graft, replace the hardware or add an electrical stimulator to encourage the fusion to heal.

PARAPLEGIA
The spine surrounds and protects the spinal cord. Surgery to the spine can damage the spinal cord. Damage to the thoracic, lumbar or sacral spinal cord can cause loss of movement and sensation in the lower half of the body, known as paraplegia. Paraplegia may be complete, with no movement or sensation below the level of the spinal cord injury, or incomplete with some movement or sensation.
Some people with incomplete paraplegia can work unsteadily, but most require wheelchairs or other supports. Urinary and fecal incontinence and impotence are common, and require the use of urinary catheters and a bowel management program (suppositories, enemas, digital stimulation). Paraplegics are at increased risk of pressure sores, thrombosis and pneumonia. Your surgeon and staff will take the utmost care to protect your spinal cord during and after your procedure.

PERFORATION
There are a number of important structures next to your operation site. These include the spinal cord and nerves and their cover — the dura, and arteries and veins. Depending upon the site of your surgery, they also include the intestine in the abdomen, the lungs in the chest, and the esophagus and trachea in the neck. Your doctor will take every care to protect these structures, but they can be accidentally perforated during the procedure. If they are injured, they will be repaired as best as possible.

PRESSURE SORES
Prolonged lying down during the procedure and the post-operative recovery can lead to skin pressure sores over prominent bones. Your medical and nursing staff will carefully place, pad and move you, to prevent this occurring.

RESIDUAL PAIN
Some pain remaining after the procedure is very common. In most cases, surgery can not restore the spine back to a pre-diseased state. Some pain should be expected to come from the area of the operation. In addition, pain from adjacent areas already damaged by the disease, or by their own degenerative problems will most likely continue. Usually any residual pain is mild, but it may be severe or even worse than the original problem.

URINARY TRACT INFECTION
While under a general anesthetic during the surgery, and when confined to bed after the surgery, you will not be able to go to the toilet to urinate. A urinary catheter will be passed along your urethra to freely drain the bladder and avoid bladder discomfort. The presence of a urinary catheter does increase the risk of bacteria entering the bladder and causing a urinary tract infection. Treatment usually requires the catheter to be removed, followed by a course of antibiotics.
This article was written with the assistance of the following surgeons.

Dr Paul Licina. Dr Licina is spinal orthopedic surgeon, and co-founder of Brisbane Orthopaedic Specialist Services in Brisbane, Queensland, Australia. www.brisbaneorthopaedics.com.au/paul_licina.html

Dr Matthew McDonald. Dr McDonald is a spinal neurosurgeon based at Wakefield Hospital, Adelaide, South Australia, Australia. www.wakefieldneurosurgery.com.au

Dr Richard Parkinson. Dr Parkinson is a spinal neurosurgeon based at St Vincent’s Clinic, Sydney, New South Wales, Australia. www.svph.com.au/index.php?option=com_content&task=view&id=145&Itemid=178

Dr Lali Sekhon. Dr Sekhon is a spinal neurosurgeon, and founder of Nevada Neurosurgery in Reno / Carson City, Nevada, USA. www.nevadaneurosurgery.com