

Minimally Invasive Spine Surgery

What is it and how will it benefit patients?



Dr Raoul Pope MBChB, FRACS, Neurosurgeon and Minimally Invasive Spine Surgeon
Concord Hospital and Mater Private Hospital Sydney

What Is Minimally Invasive Spine Surgery (MIS)?

Simply, minimally invasive spine surgery is the performance of surgery through small incision(s), usually with the aid of a microscope or visual binoculars for optimal magnified direct visualization. These small skin incisions also facilitate minimal soft tissue (mainly muscle) trauma and therefore superior pain relief, ease of mobility, and quicker discharge from hospital and earlier return to work.



Why Is Minimally Invasive Spine Surgery Advantageous?

Minimally invasive spine surgery has been around for decades and has seen 3 major phases. The 80's, 90's and now the definitive phase in the 21st century. The first 2 movements failed to convince Spine Surgeons that the technique was equivocal and certainly not superior to existing methods. It is this current movement which have many believing is the turning point for MIS to supersede traditional "Open" techniques. This has been attributed to an "explosion" of research and development, the advent of ergonomic retractor systems, and also a unified perseverance of innovative surgeons looking to push the boundaries of surgical technique and benefiting the patient in this ever-changing world and its demanding dead-lines.

Patients do not want to have time wasted recovering from Spine Surgery where they can be enjoying life or continuing productivity.

Essentially MIS developed out of the desire to effectively treat disorders of the spine with minimal muscle related injury, and with rapid recovery.

Traditionally, surgical approaches to the spine have demanded prolonged recovery time. For example, in the 1990s the state-of-the-art procedure for spine decompression and fixation of the spine was instrumented posterolateral fusion. In order to perform this procedure, the back muscles are dissected away from their spinal attachments, large retractors were cranked open stretching the stripped muscles apart allowing the surgeon room to place rods, screws, and bone graft.

First, this "Open" approach (i.e., dissecting the muscles) produces the majority of the peri operative pain and delays return to full activity. The degree of the peri operative pain necessitates the use of significant pain medication with their inherent side effects. Also, the degree of the peri operative pain delays return to normal daily activities and non-physical work.

Second, the dissection of the paraspinal muscles from their normal anatomic points of attachment results in a healing by scarring of these muscles. The various layers of the individual muscle scar to one another losing their independent function.

In addition, it has been found that this type of dissection results in the loss of innervation (i.e., the supply of nerve stimulation) of the muscles with subsequent wasting away. A permanent weakness of the back muscles results. This weakness itself may be symptomatic (as a back fatigue-type pain) and/or limit the patient's function - particularly in those who perform physical work. These side effects of the posterior approach to the lumbar spine have been called fusion disease.

Expected time to mobilisation after these open procedures would be 2 days, discharge from hospital 5-7 days, return to work 3 months.

Clearly, with such significant muscle injury associated with surgical approaches to the spine, the need existed for the development of less invasive surgical techniques. It was envisioned that minimally invasive techniques would offer several advantages including: -Reduced surgical complications - Reduced surgical blood loss - Reduced use of post-op narcotic pain medicines - Avoidance of fusion disease - Reduced length of hospital stay - Increased speed of functional return to daily activities

The Emergence of Minimally Invasive Techniques

With the advent of laparoscopic general surgery in the 1980s, other surgical specialties began searching for applications of the visualization technology. It became apparent that sections of the spine, such as the thoracic (chest) and lumbar (lower back) regions could be exposed using minimally invasive technology.

What are the benefits of minimally invasive spine surgery?

Typically, minimally invasive spinal surgery allows for the same outcomes as conventional spine surgery.

Benefits of minimally invasive back surgery include:

- A few tiny scars instead of one large scar
- Shorter hospital stay – Day Only Surgery for decompressions and a few days instead of a week or more for spine fusions
- Reduced postoperative pain and less analgesic requirement

- Shorter recovery time to normal activity - a few months instead of a year - and quicker return to daily activities, including work

Do all Spine Surgeons perform MIS?

Not all Spine Surgeons perform MIS procedures. Spine Surgery is a relatively new sub-specialty consisting of either Neurosurgeons or Orthopaedic Surgeons. Each of these specialty training programmes has a component of Spine Surgery, more heavily focused in Neurosurgery. However deformity surgery and particularly Scoliosis surgery tends to be performed by Orthopaedic Spine Surgeons.

Of these Specialists, some decide to spend a year or more after qualification performing just Spine Surgery and in some instances, focusing heavily on MIS. These Spine Surgeons are called Fellowship Trained and are usually seasoned clinicians and dedicated to Spine disorders. The majority of Neurosurgeons and some Orthopaedic Spine Surgeons may decide to attend some workshops or seminars in certain techniques offered by various Spine Instrumentation companies and then start using the techniques. They are not Fellowship trained and may be less experienced at the techniques.

Always ask your Spine Surgeon what their post-graduate training has been, and specifically in MIS.

What is the minimal training required to be proficient in MIS?

This is open to debate, but for simple decompressive surgery, various studies have cited between 30-100 cases before one is totally proficient in the technique. For Fusion procedures, the numbers are similar and Fellowship training is certainly a major advantage to have the case numbers done. The "learning curve" for mastering MIS procedures is very steep and complications are more likely in this period.

How is minimally invasive spinal surgery performed?

Conventional spine surgery requires a long incision and a lengthy recovery period. Minimally invasive surgery, also known as "keyhole" surgery, uses dilating tubes to split the muscle and fascial planes. X-rays are taken to confirm the surgical level and the working retractor piece is then inserted, "docked", and secured to the operating table for stability. This retractor can then be expanded open to reveal the surgical anatomy and a light source and/or microscope can be brought into the operating field.

Small surgical instruments may then be passed through one or more additional half-inch incisions. Following the procedure, the small incisions are closed with sutures and covered with surgical tape. After a few months, they are barely visible.

Is this technique applicable for all forms of spinal surgery?

No. Nor is it appropriate for all patients. Each patient has to be taken on their merits and individual needs. While the field of minimally invasive surgery is changing rapidly, three main types of minimally invasive spine surgery currently are being performed:

- (1) Spinal fusion, which often is performed on degenerative disks
- (2) Deformity corrections, such as for scoliosis or for fractures
- (3) Repair of herniated disks

Are some MIS cases performed with an Endoscope?

Yes, in fact the early pioneer of MIS surgery Kevin Foley from Memphis TN, described the technique utilising an endoscope and still performs it this way. It is more common in the USA and Europe but has not taken off in Australia. It requires extra skills and the benefits are not clearly better than the limitations of the technique. Also current retractor systems are so advanced, and the operating microscope so powerful, the technique is losing ground significantly.

What can patients expect after surgery?

It is important to follow the doctor's instructions after surgery. Although many people feel better after just a short while, you may need to take it easy per the doctor's recommendation.

How will patients know if minimally invasive spinal surgery is appropriate for them?

Every patient is evaluated individually. Consult the doctor about the various treatment options available.

How safe is minimally invasive spine surgery?

If performed by experts in this field, minimally invasive spine surgery is as safe as "open" spine surgery in carefully selected cases. As mentioned, non-Fellowship trained surgeons and those on the "learning curve" may encounter a higher incidence of complications or poorer clinical outcomes to their experienced colleagues.

Which conventional techniques can MIS not replace?

There are several operation approaches that are not mainstream MIS approaches. These include anterior cervical procedures such as ACDFs (Anterior Cervical Discectomy and Fusion) or cervical vertebrectomies. Anterior Lumbar approaches such as ALIFs (Anterior Lumbar Interbody Fusion) or Disc replacements. Also Posterior cervical Fusions unless it is a short segment case and plates are used.

Contrary to initial thoughts, re-do surgery may be an ideal indication for MIS surgery. The patient has to be warned in these cases and in all cases for that matter, that the operation may need to be converted to an open case, but this rarely occurs in practice.

What are the various MIS procedures that are commonly performed?

Microdiscectomy and Micro endoscopic Laminectomy

Microdiscectomy

Microdiscectomy is a very common minimally invasive surgical decompression procedure performed in patients with a symptomatic cervical or lumbar **herniated disc**. The operation consists of removing the portion of the intervertebral disc that is herniated and compressing a spinal nerve root or in the case of the neck simply freeing up the exiting nerve as it traverses the bony foramen (foraminotomy). The procedure is performed from the back (posterior) with the patient prone on their stomach.

A 2.5-cm longitudinal incision is made just off the midline of the lower back or posterior neck, directly over the area of the herniated disc. Special retractors and an operating microscope are used to visualize the region of the spine, with minimal or no cutting of the adjacent muscles and soft tissues. After the retractor is in place, an x-ray is used to confirm that the appropriate disc is identified.

A small amount of bone of the superior (above) lamina may be removed first to expose the disc herniation. The nerve root and neurologic structures are protected and carefully retracted so that the herniated disc can be removed. Surrounding areas are checked to ensure that no additional disc fragments are remaining. This procedure typically takes about 2 hours to perform.

Micro endoscopic Laminectomy

Micro endoscopic laminectomy, also called microlaminectomy, is a MIS decompression procedure performed in patients with symptomatic, painful lumbar spinal stenosis. The operation consists of removing the large, arthritic bone spurs that are compressing the spinal nerves. The procedure is performed from the back (posterior) with the patient prone on their stomach.

The approach is similar to the Microdiscectomy but the incision may be longer depending on how many levels need to be done. The surgeon will remove part of the lamina and decompress the other side and may also perform a rhizolysis (nerve root decompression), where bone overlying the affected nerve is removed with a small drill. The nerve root and neurologic structures are protected and carefully retracted so that the bone spurs can be removed. Surrounding areas are checked to ensure that no additional bone or disc fragments are remaining. This procedure typically takes about 2 to 2 ½ hours to perform.

MIS Fusion Procedures

As previously discussed, open spinal fusion is an operation that creates a solid bony union between two or more vertebrae. This procedure may assist in strengthening and stabilizing the spine and may thereby help to alleviate back and/or leg pain.

Almost all of the surgical treatment options for fusing the spine involve placement of a bone graft between the vertebrae. Bone grafts may be taken from the hip or from another bone in the same patient (autograft) or from a bone bank (allograft). Bone graft extenders and bone morphogenetic proteins (hormones that cause bone to grow inside the body) can also be used to reduce or eliminate the need for bone grafts. Almost all fusion procedures require titanium instrumentation such as pedicle screws or vertebral body plates and screws to stabilise the graft to facilitate fusion.

Fusion can also be performed via smaller incisions through MIS techniques. The use of advanced fluoroscopy has improved the accuracy of incisions and hardware placement, minimizing tissue trauma while enabling an MIS approach.

Procedures

Minimally Invasive Transforaminal Lumbar Interbody Fusion (TLIF)

Transforaminal lumbar interbody fusion is a minimally invasive surgical technique that is performed in patients with refractory mechanical low back and radicular pain associated with spondylolisthesis, degenerative disc disease, and recurrent disc herniation. The TLIF approach may also have potential in patients with low back pain caused by post-laminectomy instability, spinal trauma, or for treating pseudoarthrosis.

The procedure is performed from the back (posterior) with the patient prone on their stomach. The major difference in the TLIF approach to the PLIF (posterior lumbar Interbody Fusion) is that the operation is performed unilaterally, and the bone graft is inserted into the disc space through the one side, whereas the PLIF cage is bilaterally placed.

Using x-ray guidance, a 2- to 4-cm incision is made approximately 4 to 5 cm lateral to the midline. The muscles are gradually dilated and a tubular retractor is inserted to allow access to the affected area of the lumbar spine. The lamina is removed to allow visualization of the nerve roots, and the facet joints may be trimmed or removed to allow more room for the nerve roots.

The disc material is removed from the spine and replaced with a bone graft and structural support from a cage made of bone, titanium, carbon-fibre, or a polymer, followed by rod and screw placement. Surgeons may position small screws on the other side of the spine through a percutaneous technique to provide additional stability. The tubular retractor is removed, allowing the dilated muscles to come back together, and the incision is closed. This procedure typically takes about 3 ½ -4 hours to perform.

Minimally Invasive Lateral Interbody Fusion (XLIF, Nuvasive)

eXtreme Lateral Interbody Fusion (XLIF) are minimally invasive surgical procedures performed in patients with spinal instability caused by degenerative discs and/or facet joints that cause unnatural motion and pain, loss of height of the disc space between the vertebrae that causes pinching of the spinal nerves exiting the spinal canal, slippage of one vertebra over another, and/or changes in the normal curvature of the spine. The primary difference in these approaches is the area of the body through which the spine is accessed.

To access the lateral spine and disc space retro-peritoneally, a 3-cm incision is made on the patient's side, usually with a second 2.5-cm incision just behind the first one. Special retractors are utilized, in addition to fluoroscopy, which provides intraoperative x-ray images of the spine. A tubular retractor or portal is passed and positioned along the lateral aspect of the vertebral bodies being operated upon.

Nerve monitoring equipment is used to determine the placement of the instruments in relationship to the spinal nerves. Disc material is removed from the spine and replaced with a bone graft, along with structural support from a cage made of bone, titanium, carbon-fibre, or a polymer. This provides extra stability and helps the bone heal. Sometimes, surgeons will position small screws in the spine posteriorly percutaneously through an additional prone procedure.

This procedure is limited to one or two levels, and only vertebra that can be clearly accessed from the side of the body can be operated on. This procedure typically takes about 2 to 2½ hours to perform.

Summary

MIS is an evolving sub-specialty of Spine Surgery and in some cases superseded traditional open techniques. However the proportion of Spine Surgeons practising this form of surgery is still the minority, and traditional Open techniques prevail. This will change markedly over the next 5 years as the new-age Spine Surgeons practice MIS, and the incumbent surgeons increase their experience.

As history has revealed, time will be the judge, and the clinical results of MIS compared to traditional techniques are being evaluated constantly and so far looking at least equivocal and in many series superior.

Watch this space!

Feel free to Contact Dr Pope to learn more about MIS or to refer patients for evaluation.

Ph: 9911 7280 pope@spinesurgeon.com.au www.spinesurgeon.com.au