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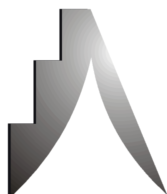


**Australian Safety and Efficacy Register of New Interventional Procedures – Surgical**

## Consumer summary

## Percutaneous endoscopic laser discectomy

(Adapted from the report of the Review Group for consumer use by Ms M. Boult)

To navigate in this document in Word:

- Click on the word (underlined in blue) to link to glossary.
- Use back arrow on tool bar to return to original place in document.

The purpose of this review by ASERNIP-S was to systematically review the medical literature regarding the safety and efficacy of percutaneous endoscopic laser discectomy compared with open discectomy for the surgical treatment of herniated lumbar discs. In addition to the findings of the review, and the recommendations made by ASERNIP-S to the Royal Australasian College of Surgeons, some background information on the spine and disc surgery has been included.

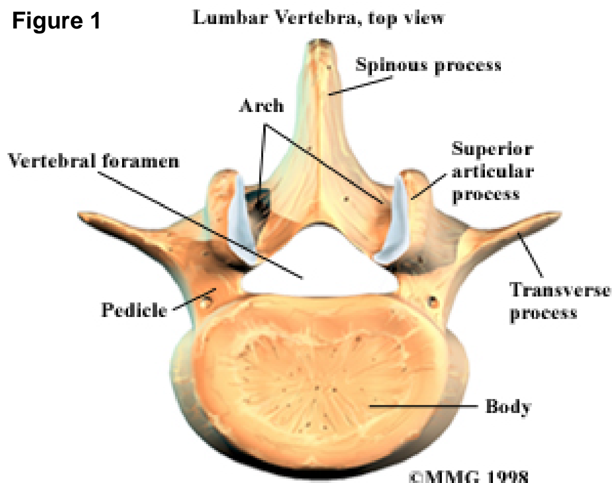
### Low Back Pain

Low back pain is the most common and expensive cause of chronic disability in adults younger than 45 years of age and is one of the most frequent reasons for early retirement in industralised societies. Although most people who experience attacks of low back pain will recover within several weeks, a significant proportion will develop chronic low back pain affecting their quality of life and ability to work.

## Anatomy of the spine

The spinal column is made up of 33 segments of bone known as vertebrae which are held together by tough bands of tissue called ligaments. The function of the vertebrae is to provide support and protection to the spinal cord. Each vertebral bone is composed of a solid part (the body) and a ring of bony processes (see figure 1). When the vertebrae are stacked on top of one another, they form a curved column of bones and a bony tube. The tube formed by the bony rings is known as the spinal canal and is where the spinal cord is situated (see figure 2). The spinal cord is a cylinder of nerve tissue, containing bundles of nerve fibre tracts and nerves, which send messages to and from the brain. The nerves emerge in pairs through the openings between the vertebrae. Nerves are the body's communication system; they control the muscles in the body and carry messages back and forth between the brain and all body parts. At the point the nerves emerge from the vertebrae they are called nerve roots. If the nerve roots are pinched, pain, numbness or weakness may ensue.

Figure 1

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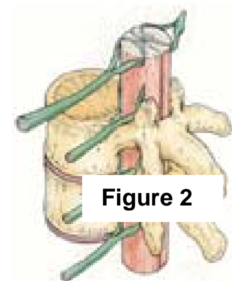


Figure 2

Traditionally the back is described in terms of five sections according to the position of the vertebrae - the cervical, thoracic, lumbar, sacral vertebrae and the coccyx or tailbone. There are seven cervical vertebrae referred to as C-1 to C-7 comprising the bony axis of the neck, and twelve thoracic vertebrae (T-1 to T-12) which are larger than those in the cervical region. The five lumbar vertebrae (L-1 to L-5) in the lower back area are larger and stronger than the cervical and thoracic vertebrae above them, as they support more weight. Below the lumbar region, the sacrum is composed of five attached vertebrae

arranged as a triangular structure that forms the base of the vertebral column. The spinal column end at the coccyx, which is composed of four tiny, fused vertebrae.

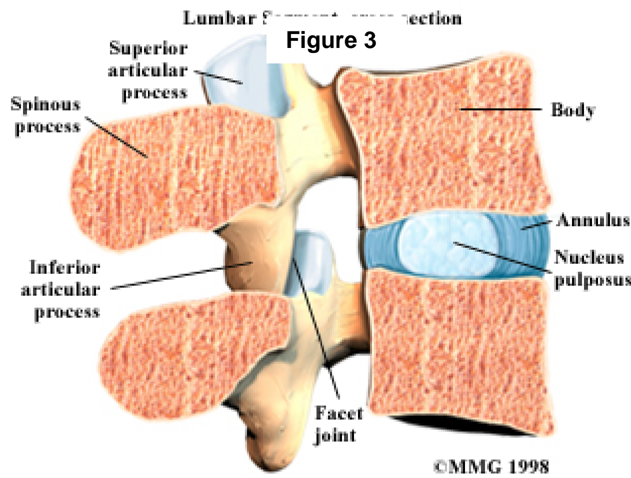


Figure 3

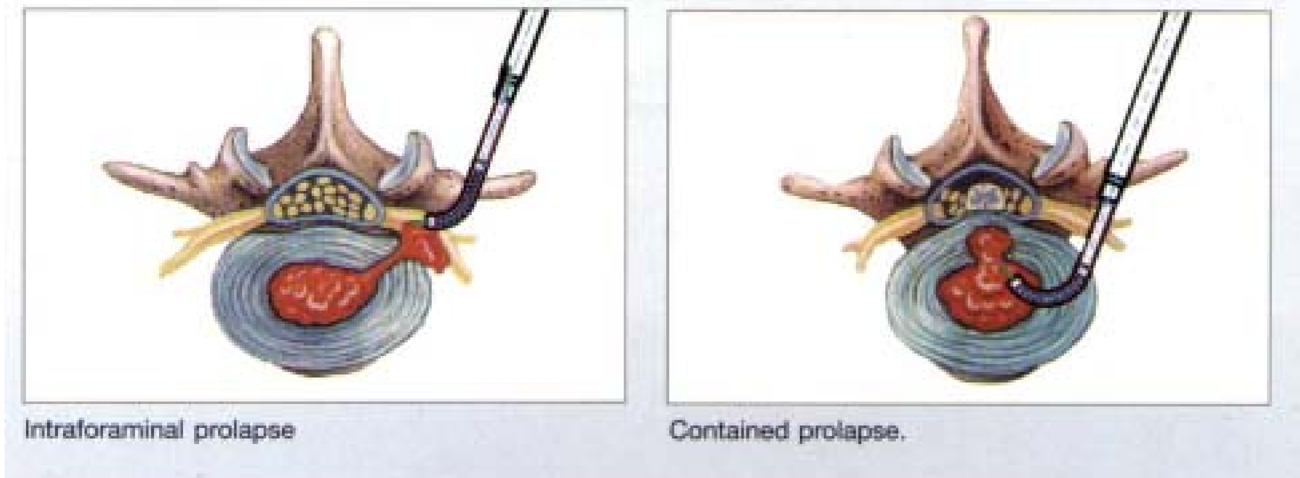
http://www.sechrest.com/mmg/shoulder/index.html

Between the solid part of each vertebrae sits a connecting intervertebral disc. As shown in figure 3, the discs are like round “cushions”, the centre of which is filled with a jelly-like substance called the nucleus pulposus which is responsible for the shock absorption properties of the spine. Surrounding the nucleus pulposus is a firm covering called the annulus fibrosis (referred to as annulus in figure 3). The annulus fibrosis is the strongest part of the intervertebral disc and interconnects with the vertebrae via ligaments.

Frequently, back pain is the result of injury or degeneration of the intervertebral disc. Degeneration is a process of wear and tear resulting in the deterioration of the disc and frequently occurs in adults 35 years and older. It is thought that this deterioration starts with tears in the annulus fibrosis. The tears can heal, but in doing so, create scar tissue which is not as strong as normal tissue. Over time, with repeated tearing of the annulus fibrosis, the disc finally begins to deteriorate. As a consequence a minor event such as sneezing or twisting the back can cause the nucleus pulposus to prolapse (herniate), which may result in lower back pain.

**Herniated intervertebral discs**

Herniated intervertebral discs may also be referred to as “slipped”, “prolapsed”, “bulging” or “ruptured” discs and are a common cause of pain in the community. The herniation is a protrusion or squeezing out of the nucleus pulposus though a tear in the surrounding annulus fibrosis.




The annulus fibrosis may tear completely resulting in an extruded (non-contained) disc or remain intact but stretched, resulting in a contained disc prolapse (see figure 4). A lumbar prolapse may compress one or more nerve roots, resulting in pain down the leg and in the lower back. Sciatic pain (sciatica) occurs when the disc presses one of the nerve roots that form the sciatic nerve. The sciatic nerve is the main nerve of the leg and the largest nerve of the body. It sends signals down the leg to control the muscles and up the leg to provide sensations. A "pinched" sciatic nerve is often recognised early on by numbness in the area supplied by the nerve and later, by pain in the same area, usually extending below the knee to the foot. There may also be a numbness and weakness of the back and legs. In rare cases, there may be loss of control of the bladder and bowels.

The most common site for herniation is the lumbar region, although it may occur anywhere along the spine. The lumbar levels most commonly affected are between the fifth lumbar and first sacral vertebrae (L-5 – S-1) and between the fourth and fifth lumbar (L4 – L5).

**Diagnosis of herniated intervertebral discs**

Confirmation of herniation of intervertebral discs requires imaging with either MRI (magnetic resonance imaging) or CT (computed tomography), which will show the disc, the space behind it and in

the case of MRI, the nerves. EMG (electromyography) may be indicated in some cases to show the functionality of the nerves and muscles. Plain X-rays may also be useful in the first instance to reveal any degenerative changes in the bones of the spine. Imaging techniques are also useful to enable the diagnosis of other conditions, for example, lumbar stenosis or cysts of the synovial joint.

In addition to imaging techniques, the doctor will assess the patient's history of back pain and conduct a thorough physical examination. Additional tests may be conducted on the blood and urine to rule out other causes of back pain such as arthritis.

**Treatment for herniated intervertebral discs**

Most herniated lumbar discs are treated conservatively. This means engaging in therapies that are non-operative, and which may include bed rest, drug therapy involving the use of analgesics and anti-inflammatory drugs, and physiotherapy. If conservative therapy is insufficient to substantially relieve pain, then surgery may be considered in addition to conservative therapy. Most cases of back pain due to herniated lumbar discs pressing on nerve roots will resolve with conservative treatment.

The aim of surgery for herniated lumbar discs is to provide symptomatic relief of pain caused by a prolapsed disc pressing on adjacent nerve roots. The most common surgical procedure for herniated or prolapsed lumbar discs is open discectomy. This procedure is well established and is recognised as the "gold standard" treatment. It involves removing part of the herniated disc whilst the patient is under general anaesthesia. An incision is made through the skin; the muscles of the spine are separated from the vertebra above and below the affected disc to allow access. A small amount of bone is removed to create a "window" through which the disc and nerve can be seen. Where there is loose disc material this is removed. If part of the annulus fibrosis surrounds the displaced disc material, then the fibres and fragments of disc are removed. Sometimes, additional portions of nucleus pulposus are removed from

the disc space. This procedure is also known as a laminectomy, or microdiscectomy where the surgeon uses a binocular microscope to improve his /her field of view.

In addition to open discectomy there are numerous surgical treatments for herniated lumbar discs which are described as percutaneous. Percutaneous simply means "through the skin", but by implication means that the procedure is minimally invasive as it is performed through very small incisions in the skin. There is a range of percutaneous treatments available for herniated lumbar discs that vary according to the instruments or chemicals used. The techniques include:

> Endoscopic discectomy, laser discectomy, chemonucleolysis, automated percutaneous discectomy.

In this ASERNIP-S review the procedure percutaneous endoscopic laser discectomy was evaluated. Percutaneous endoscopic laser discectomy is a minimally invasive surgical procedure that was developed to relieve pain caused by a contained prolapsed disc, i.e. where nucleus pulposus has migrated into a small tear in the annulus fibrosis resulting in some bulging. If the annulus is completely torn and the nucleus pulposus protrudes from it, or there is a detached fragment of disc, open discectomy is the procedure of choice.

The primary advantage of percutaneous endoscopic laser discectomy is that it can be performed as a day surgery procedure as only slight sedation is required. This may mean that there will be a shorter hospital stay and recovery period, and lower costs. Other benefits that have been reported for percutaneous endoscopic laser discectomy include reduced scar tissue and better visualisation than other non-endoscopic percutaneous techniques. It has also been suggested that if the percutaneous endoscopic laser discectomy procedure is not successful for any reason it does not preclude the possibility of a second operation by a different method.

The procedure involves the insertion of a probe through a small incision in the skin of the back, into the centre of the herniated disc. An endoscope is used to assist visualisation of the disc space. Laser energy is delivered through the probe to vaporise part of the nucleus pulposus. By reducing the volume of the nucleus pulposus, there is a simultaneous decrease in the pressure within the disc which may reduce the pressure on the nerve root and resolve the associated pain and numbness.

The percutaneous endoscopic laser discectomy technique is a variant of other percutaneous techniques such as percutaneous laser discectomy (PLD) and automated percutaneous discectomy (APD). PLD uses laser energy to remove part of the nucleus pulposus; but the operation is performed under the guidance of an external imager called a fluoroscope. APD uses an endoscope to guide mechanical instruments which are used to remove the nucleus pulposus.

**Safety of percutaneous endoscopic laser discectomy and open discectomy**

There has not been enough specific information about percutaneous endoscopic laser discectomy published in the scientific literature to draw any firm conclusions about the safety of the procedure. Up until the end of 1999 there were only 12 articles in the published medical literature that referred to the procedure; most of these were simple descriptions of the technique. None reported any major problems with safety. Minor problems described in one paper included a single cases of: infection, suspected discitis, transient skin discomfort and transient nerve block.

It has been suggested that possible safety issues which may arise from the use of percutaneous endoscopic laser discectomy include:

- Potential injury from the thermal effects of laser energy
- improper placement of the laser fibre causing nerve damage
- Inadequate decompression of the disc requiring a second operation

Open discectomy is a well established procedure about which many papers have been written. Apart from the complications inherent in every surgical procedure performed under general anaesthesia, the most common complications associated with open discectomy are nerve damage and infection. Rare complications include bleeding and disturbed bladder, sexual or bowel function. Serious complications including death and neurological damage involve far less than 1% of patients, whilst moderate complications such as wound infections and discitis affect less than 2%.

**Effectiveness of percutaneous endoscopic laser discectomy and open discectomy**

No firm conclusions can be drawn regarding effectiveness of the percutaneous endoscopic laser discectomy procedure due to the lack of evidence. The percentage of patients requiring a second operation, or where the operation was not regarded as successful, ranged from 10 to 16% in the available literature.

The literature for open discectomy shows it to be a reasonably effective form of surgical treatment for herniated lumbar discs; with good results reported for 65 – 85% of patients. There is also good evidence that the procedure is more effective for the treatment of sciatic pain in the short term than chemonucleolysis. This is promising for chemonucleolysis has been found to be more effective than a placebo. Open discectomy has not been compared with other percutaneous techniques in well-designed trials. However there is limited (low-level) evidence that automated percutaneous discectomy is less effective than open discectomy or chemonucleolysis. No reliable trials have evaluated percutaneous laser discectomy.

**Recommendations of the Royal Australasian College of Surgeons**

The review undertaken by the ASERNIP-S revealed a dearth of published literature on percutaneous endoscopic laser discectomy and an absence of high quality evidence within the studies identified. That is, both the design and implementation of most of the studies undertaken was flawed such that biases could not be confidently discounted. The Royal Australasian College of Surgeons has therefore endorsed the conclusion of ASERNIP-S that the safety and/or efficacy of percutaneous endoscopic laser discectomy cannot be determined due to an incomplete and/or poor quality evidence-base. It is strongly recommended that further research be conducted to establish safety and/or efficacy of the procedure.

**Acknowledgments**

Collins Dictionary of Medicine, Robert M Youngson, Harper Collins Publishers, Glasgow Churchill Livingstone Pocket Medical Dictionary, 13th Edition Ed Nancy Roper Edinburgh Scotland.

Some excellent anatomical drawings and animations of the shoulder are available online from the Medical Multimedia Group: www.medicalmultimediagroup.com/opectoc.html. All the diagrams contained in this article derived from this source.

**Key words: percutaneous laser disc surgery, percutaneous laser discectomy (diskectomy/ discotomy/ diskotomy), percutaneous endoscopic laser discectomy or PELD**

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**Important Note:** The information contained in this report is a distillation of the best available evidence located at the time the searches were completed as stated in the protocol. Please consult with your medical practitioner if you have further questions relating to the information provided, as the clinical context may vary from patient to patient.

**For further information about ASERNIP-S**
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If you would like to provide feedback on this consumer summary, please contact us at consumer.asernip@surgeons.org .

ASERNIP-S is a programme of the Royal Australasian College of Surgeons (RACS).

**Glossary**

**Analgesics:** pain-relieving drugs.

**Annulus fibrosis:** a tough ring of fibrous tissue which surrounds the nucleus pulposus in the intervertebral disc.

**Anti-inflammatory drugs:** drugs that act against inflammation.

**Cysts:** abnormal, usually spherical walled cavities filled with secreted fluid or semi-solid matter derived from the cyst itself.

**Discitis:** inflammation of the disc.

**Endoscope:** an instrument for visualisaton of body cavities or organs.

**Evidence-based:** the body of research used to investigate the procedure in question.

**General anaesthesia:** a state of unconsciousness and immobility brought about by drugs, so as to allow surgical operations or other physical procedures to be performed without pain or awareness.

**Herniate:** see prolapse

**Intervertebral disc:** Roundish structure that function as "shock absorbers" to cushion the spine and form the bending points between vertebrae.

**Ligaments:** bundles of strong bands that connect bone to bone and give stability to the spine during movement.

**Lumbar stenosis:** narrowing of the spinal canal, resulting in compression of the spinal cord or nerve roots, cutting off their impulses to the muscles of the leg.

**Nucleus pulposus:** soft, jelly-like material inside the intervertebral disc.

**Percutaneous discectomy:** a minimally invasive procedure carried out through small incisions in the back, to remove bits of the disc that are pressing against nerve roots

**Percutaneous:** through the skin.

**Prolapse:** with respect to intervertebral discs – the protrusion of the nucleus pulposus through a tear in the surrounding annulus fibrosis.

**Radicular pain:** pain associated with compressed nerve root.

**Spinal canal:** the opening formed by the open rings of the vertebrae, through which the spinal cord runs.

**Spinal column:** the spine.

**Spinal cord:** the root section of the central nervous system that runs down from the brain, through the spinal column, where it divides into nerves.

**Synovial joint:** freely movable joint with lubricated bearing surfaces.

**Thermal effects:** the effects of heat.

**Transient:** something which passes with time, not lasting or enduring.