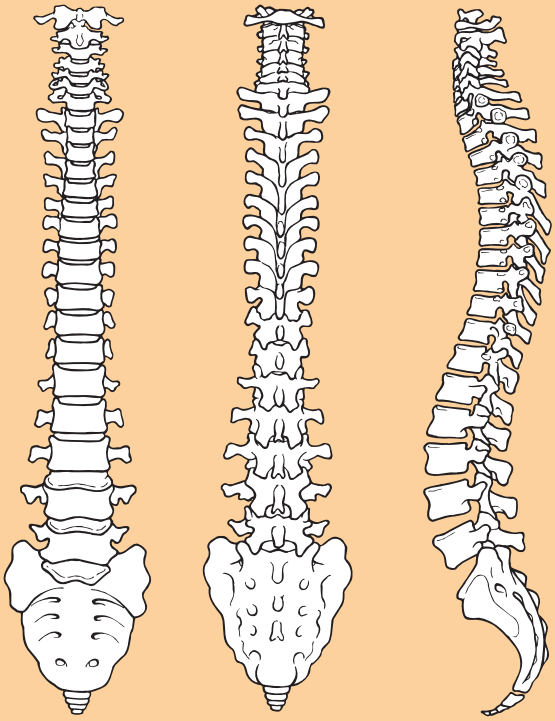
BASS
British Association of Spine Surgeons

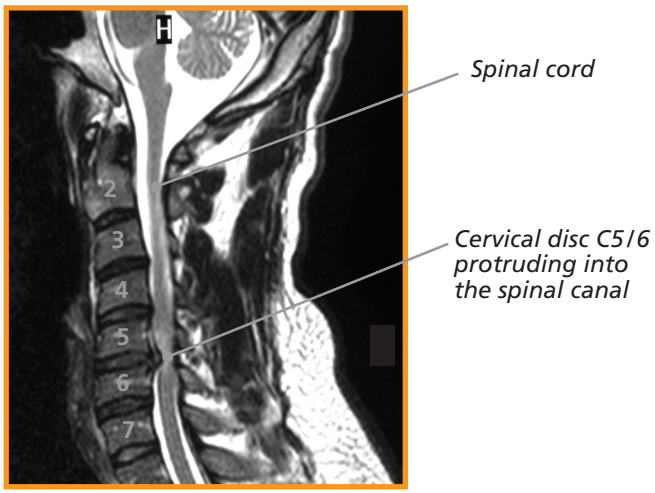
Cervical Disc Protrusion and Radiculopathy: Surgical Options



Issue 2: November 2018
Review date: October 2021

Following your recent MRI and consultation with your spinal surgeon, you have been diagnosed with cervical radiculopathy which is a nerve root compression (trapped nerve), resulting in arm pain. This is usually due to a cervical disc protrusion or a bony spur (osteophyte).

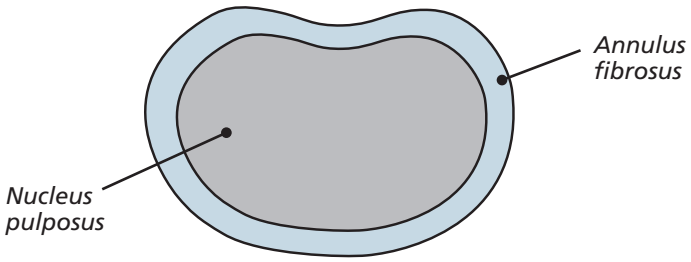
MRI scan showing a disc protrusion between C5 and C6



The normal spinal column has a central canal (passage) through which the spinal cord passes down. To each side of the canal, spinal nerve roots branch out at every level. The spinal cord and nerve roots are surrounded by cerebrospinal fluid (CSF) and are contained within a membrane, or covering, called the dura mater, rather like the thin layer that covers a boiled egg.

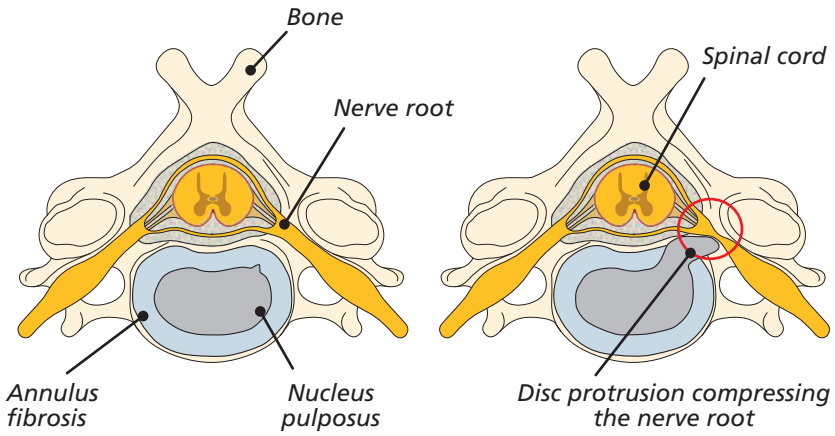
There are seven bones (vertebra) in the neck. In between each bone is an intervertebral disc which acts as both a spacer and a shock absorber. The disc is composed of two parts: a soft gel-like middle (nucleus pulposus) surrounded by a tougher fibrous wall (annulus fibrosus).

Overhead view of an intervertebral disc (simplified)



Over time, as degeneration (wear and tear) occurs, the intervertebral disc can lose its flexibility, elasticity and shock absorbing characteristics. The tough fibrous wall of the disc may then weaken and split and no longer be able to contain the gel-like substance in the centre. This material may **bulge** or push out through a tear in the disc wall (**herniation**), causing pain when it touches a nerve.

Overhead view of an intervertebral disc



Nerve root pain is felt in the area of the body that the nerve supplies after it leaves the spine. A nerve is like an electrical wire. It tells your muscles to move and gives your brain information about various sensations such as pain, temperature, light touch, pressure sensation and position of your arm.

Shooting pain down the arm (brachial neuralgia) is very like sciatica but comes from the nerves as they leave the neck. Symptoms may include pain, pins and needles, numbness, increased sensitivity or weakness of the muscles in the arm and/or hand and fingers. If the problem is at the top of the neck, symptoms usually go into the shoulder; lower down, there may be pain or pins and needles in some of the fingers.

If there is nerve damage, there may be numbness or weakness in the arm or hand. If this is significant, the specialist is more likely to recommend surgery earlier to give the nerve the best chance of recovery.

Very few people though, who have a cervical disc prolapse, need surgery. It is unusual to operate before 6–8 weeks because a significant number of people do get better naturally. This can happen if the disc or swelling around a nerve decreases naturally (with time) or is helped by image-guided steroid injection.

Six out of 10 patients can get better spontaneously by six weeks, while 7–8 out of 10 patients will feel better by three months. In general, most people with arm symptoms will get better over time. Other than signs of nerve damage, surgery is usually only considered by a doctor when the pain is very bad and has not got better with strong pain relief after this time.

There is a balance of waiting whilst nature gets you better, versus waiting too long which might prolong your suffering and pain or compromise nerve function (weakness, numbness or pain recovery).

The nature of spinal surgery is not to ‘cure’ and cannot prevent further disc degeneration but is aimed to provide benefit with a high percentage improvement and relief of arm symptoms. Sometimes, however, numbness or weakness can persist (even with a technically successful operation). Good relief from arm pain following surgery usually occurs in approximately 85–90% of cases (up to nine out of 10 people). This is not necessarily felt immediately but over a period of time (sometimes several

weeks). Relief from neck pain, however, is more difficult to predict and it should not be regarded as the main aim of the surgery. It is therefore unlikely that this type of surgery would be performed for people suffering neck pain alone without experiencing other symptoms.

The operation

There are different techniques when performing an operation for a cervical disc prolapse or bony spurs. Expected outcomes from all methods are very similar and the choice of operation will be decided by your surgeon, who will take into consideration the persistent symptoms in the arm(s) and any other problems you might have such as cervical facet joint degeneration (arthritis), osteoporosis (fragile bones), any spinal instability (wobbly spine) or previous neck surgery.

The approach (way in) to the cervical spine can also vary from either the front (anterior) or back (posterior) of the neck, although more commonly it is performed from the front.

Anterior cervical discectomy and interbody fusion (ACDF)

Cervical discectomy (removal of disc) and interbody fusion can be performed when there is a level of degeneration (arthritis) and a disc protrusion causing nerve root compression. With this technique, the cervical disc is completely removed and the segment is fused (joined) together. This will remove the pressure off the nerve root and prevent the painful cervical joint from moving.

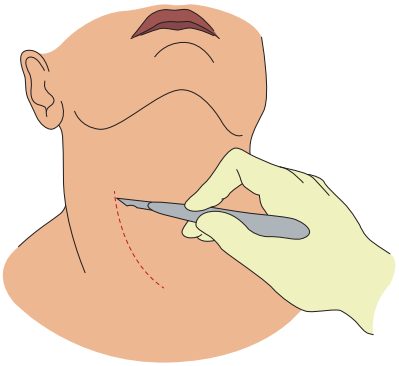
The approach is made through an incision in the front of the neck. Often one small muscle is cut and then the oesophagus (food pipe) and the trachea (windpipe) are retracted (held back) off the spine. A microscope can be used at this point to give greater magnification of the structures. The disc space is then distracted (jacked up) to a more normal disc height to widen the canal for the nerve root and to help relieve the pressure. The

surgeon then removes the cervical disc. More than one disc may be removed if necessary.

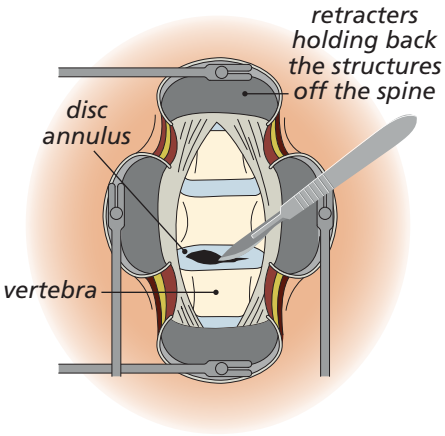
Removal of the disc also enables the surgeon to remove bony spurs (osteophytes) pushing onto the nerve roots, ensuring they have more room. The disc space is then filled with bone graft and/or a cage which can contain bone graft.

This approach has risks and complications which are specific to it and are listed below the general ones (see 'Risks and complications').

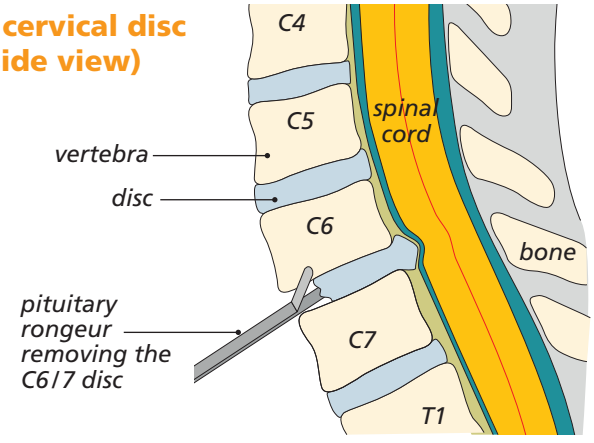
The incision is made to expose the cervical spine



The skin and muscles are held back off the spine before the disc is removed



Removal of the cervical disc protrusion (side view)



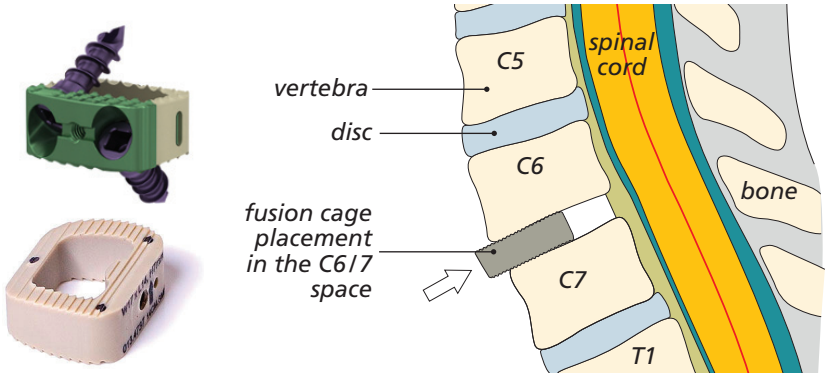
Stabilisation

1 **Bone graft.** This is used to fuse (join together) and stabilise the spine, often in conjunction with other techniques. When it is placed in the spine your new bone will, over time, grow into the bone graft. This is a biological process over 3–6 months, known as spinal fusion. There are several techniques to get the bone graft needed for spinal fusion:

- **artificial bone (synthetic bone)** These are bone-like substances and are most commonly used;
- **patient's own bone (autograft bone).** This can be taken from the pelvis (iliac crest) if required; or
- **donor bone (allograft bone).** Donor bone graft does not contain living bone cells but acts as calcium scaffolding which your own bone grows into and eventually replaces.

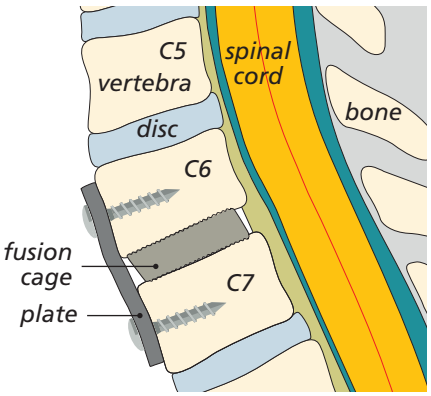
2 **Intervertebral fusion cage.** This is like a hollow Lego brick which props up the disc space between the two bones (vertebra). It is a tight fit and gives immediate stability. The cage is available in different width, height and depths to fit your spine exactly. It is made from carbon fibre, PEEK (reinforced plastic) or titanium metal. The cage can be filled with bone graft or artificial bone if required and used in anterior cervical spine surgery. In some instances, it may be appropriate to fix the cage more robustly with screws into the bone above and below.

Example of fusion cages and the placement of one type into the disc space (side view)

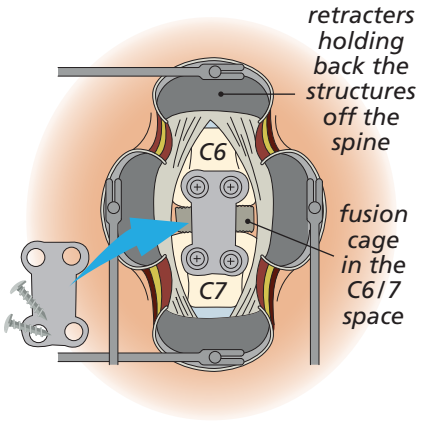


3 **Anterior plate fixation.** A metal (titanium) plate can be applied to the front of the cervical spine to add stability and prevent graft and/or cage dislodgement. Titanium is a light metal and is compatible with MRI studies after the surgery. Generally though, for most patients, a well-fitting cage means that this is not required. It may however, be necessary if more than two levels are operated on or your surgeon feels that your bone healing might be slow (such as when taking strong arthritis drugs) or if you have a 'wobbly' (unstable) spine. The plate is placed over the area and is screwed into the vertebral bodies above and below the disc space.

Anterior plate fixation: Side view



Anterior plate fixation: Front view



X-ray showing the plate and cages in position

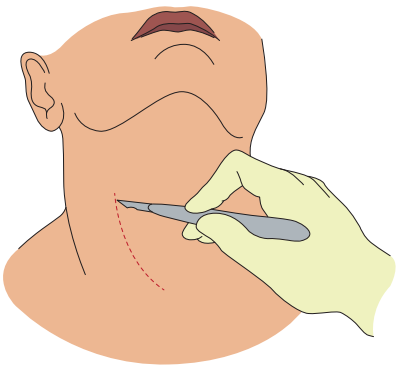
Anterior cervical discectomy and disc replacement (ACDR)

Cervical discectomy (removal of disc) and artificial disc replacement can be performed when there is a disc protrusion causing nerve root compression but no evidence of degeneration (arthritis), osteoporosis or cervical instability. This is a more recent development in spine surgery. With this technique, the cervical disc is completely removed and the segment filled with a replacement artificial disc. This will remove the pressure off the nerve root and maintain some movement of the segment (5–8 degrees up and down).

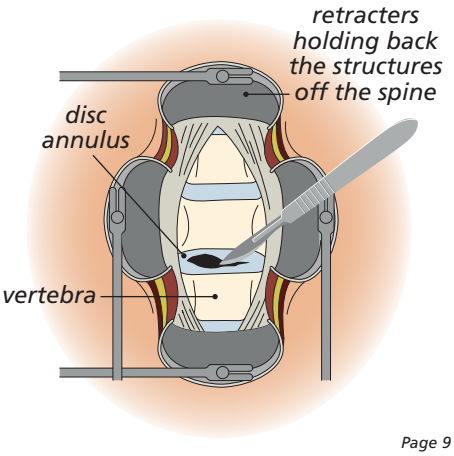
The approach is made through an incision in the front of the neck. Often one small muscle is cut and then the oesophagus (food pipe) and the trachea (windpipe) are retracted (held back) off the spine. A microscope is usually used at this point to give greater magnification of the structures. The disc space is then distracted (jacked up) to a more normal disc height to widen the canal for the nerve root and to help relieve the pressure. The surgeon then removes the cervical disc and using X-rays as guidance, the artificial disc is implanted into the space.

This approach has risks and complications which are specific to it and are listed below the general ones see 'Risks and complications').

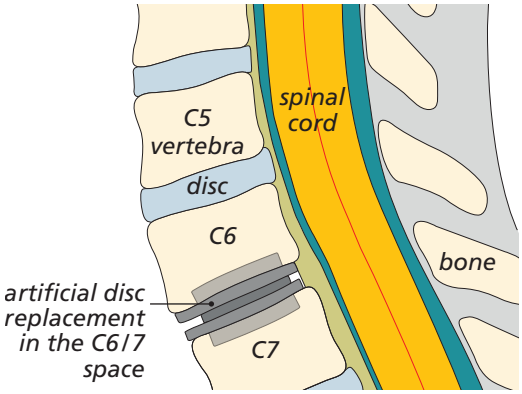
The incision is made to expose the cervical spine



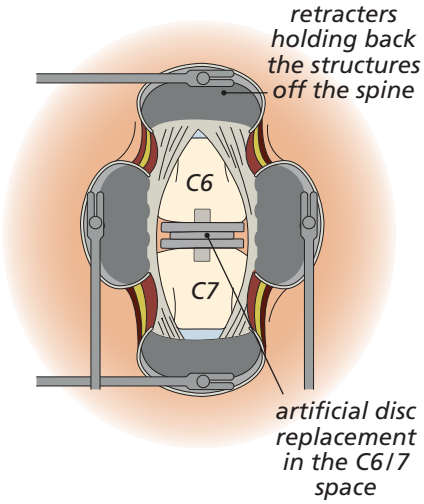
The skin and muscles are held back off the spine before the disc is removed



Artificial disc in position: Side view



Artificial disc in position: Front view

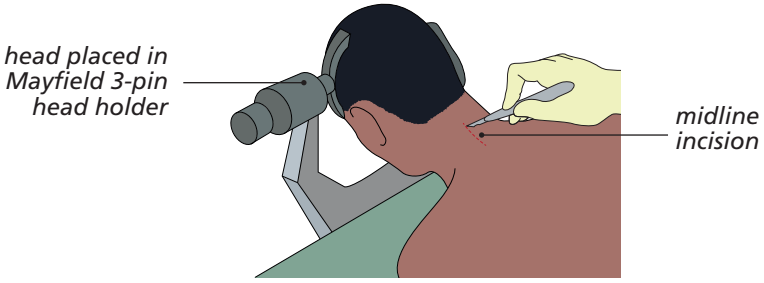


Posterior cervical foraminotomy

Foraminotomy surgery is a spinal decompression operation to relieve the pressure on the nerve roots, where they branch out from the spinal cord through the intervertebral foramina (the opening between each vertebrae). This involves making a hole in the lamina (bony arch) that covers and protects the spinal canal and spinal cord at the back of the neck. This procedure aims to give more room for the nerve and is generally chosen when patients have had previous anterior (from the front) neck surgery, to prevent the increased risk of complications with revision (re do) surgery.

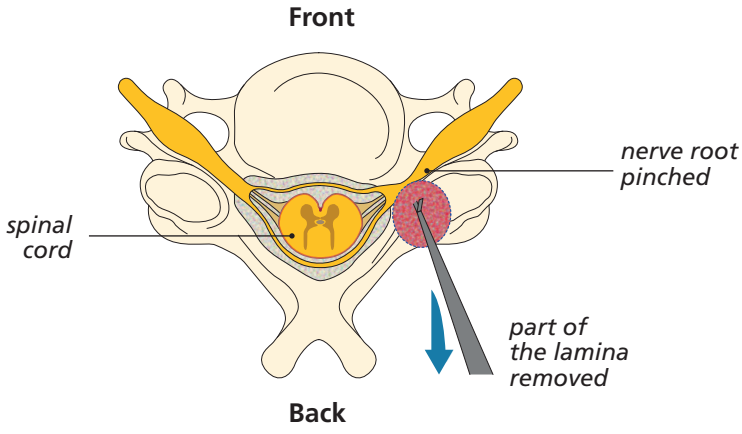
Because it is performed with the patient lying on their front and to ensure that the head and neck are kept very still throughout the operation, it is necessary to apply temporary pins into the skull which are attached to a special clamp (Mayfield clamp) allowing the head to be suspended securely over the operating table. These are usually put in and removed while the patient is under anaesthetic or heavily sedated (asleep).

The surgical approach

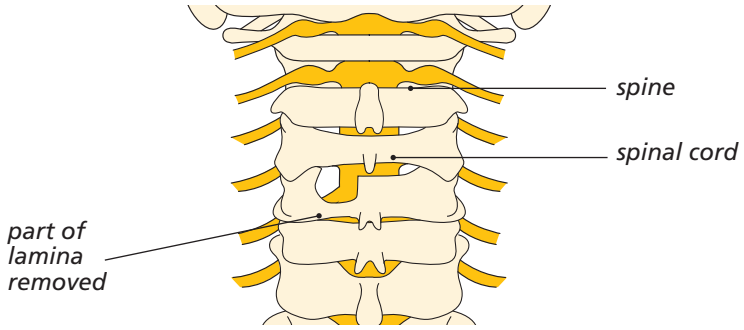


The approach is made through an incision in the midline at the back of the neck. The muscles are then held apart to gain access to the bony arch and roof of the spine (lamina). A small 'window' is made by removing bone carefully, using a high-speed burr (like a dentist's drill) and/or fine cutting instruments (usually on one side but can be both). Sometimes this can be performed through a narrow tube to reduce muscle dissection and injury (known as **minimally invasive (tubular) foraminotomy**).

Bone is removed from the back of the nerve root



Bone removed from the back of the nerve root (back view)



Risks and complications

As with any form of surgery, there are risks and complications associated with this procedure. These include:

- **damage to a nerve root.** This occurs in less than 1 out of 100 cases of primary surgery, but is much more common in revision or 're-do' surgeries where injuries can occur in up to 10 out of 100 cases. If this happens, you may get weakness in the muscles supplied by that particular nerve root and/or numbness, tingling or hypersensitivity in the area of skin it supplies;
- **tearing of the outer lining or covering which surrounds the nerve roots (dura).** This is reported in fewer than 1 out of 100 cases. It may occur as a result of bone or the disc being very stuck to the lining and tearing as it is lifted off. Again, it is much more common in 're-do' surgery. Usually the hole or tear in the dura is repaired with stitches, a patch or a special glue. If the puncture or hole re-opens then you may get cerebrospinal fluid (CSF) leaking from the wound, headaches or, very rarely, meningitis. Although rare, the problems of leakage can persist. This could result in you having to return to theatre to enable the surgeon to revise the repair of the dura but the risk of a second operation being required within a few days or weeks is less than 0.05%;
- **recurrent arm pain**, as a result of scarring;
- **problems with positioning** during the operation which might include pressure problems, skin and nerve injuries and eye

complications including, very rarely, blindness. Special gel mattresses and protection is used to minimise this;

- **bleeding.** You **must** inform your consultant if you are taking tablets used to 'thin the blood', such as warfarin, aspirin, rivaroxaban or clopidogrel. It is likely you will need to stop taking these before your operation. Taking medication like non-steroidal anti-inflammatories (NSAIDs) could also increase your risk of bleeding and your surgeon will advise you if you need to stop taking these in advance of your operation. If your operation is scheduled with only a week's notice, please check with your consultant or nurse which drugs need to be stopped to prevent your surgery being delayed;
- **infection.** Superficial wound infections may occur in up to 4 out of 100 cases. These are often easily treated with a course of antibiotics. Deep wound infections may occur in fewer than 1 out of 100 cases. These can be more difficult to treat with antibiotics alone and sometimes patients require more surgery to clean out the infected tissue. This risk may increase for people who have diabetes, an impaired immune system or are taking steroids. As our skin and hair harbour bacteria, it is often necessary to shave the back of the hair when performing posterior cervical spine surgery. This prevents hairs falling into the wound during the operation. Men undergoing anterior cervical spine surgery who have a beard may be asked to shave before the operation but to be careful not to cut themselves and risk skin infections, as this could delay the surgery going ahead;
- **blood clots (thromboses) in the deep veins of the legs (DVT) or lungs (PE).** These occur when the blood in the large veins of the leg forms blood clots and may cause the leg to swell and become painful and warm to touch. Although rare, if not treated this could be a fatal condition if the blood clot travels from the leg to the lungs, cutting off the blood supply to a portion of the lung. It is reported as happening in fewer than 1 out of 100 cases. There are many ways to reduce the risk of a blood clot forming. The most effective is to get moving as soon as possible after your operation. Walk regularly as soon as you are able to, both in hospital and when you return home. Perform the leg exercises as

shown to you by the physiotherapist and keep well hydrated by drinking plenty of water. Women are also advised to stop taking any medication which contains the hormone oestrogen (like the combined contraceptive or HRT) four weeks before surgery, as taking this during spinal surgery can increase the chances of developing a blood clot;

- **bone graft non-union or lack of solid fusion (pseudoarthrosis).** This can occur in up to 5 out of 100 cases. (see 'Factors which may affect fusion' section);
- **possible complications associated with taking out bone graft from the iliac crest (pelvis)** include graft site pain and damage to a sensory nerve that supplies sensation to the front of the thigh (the lateral femoral cutaneous nerve). Most surgeons however, will use cages and/or artificial bone to avoid this risk; and
- in the long term, or in years to come, **pain can develop** from problems at other levels in the neck (adjacent level segment disease). Surgeons may take this into consideration when choosing which technique is the best for you but some people are susceptible to this anyway because of genetic or environmental issues.

There are also very rare but serious complications that in extreme circumstances might include:

- **damage to the spinal cord and paralysis** (the loss of use of the arms and legs, loss of sensation and loss of control of the bladder and bowel). This can occur through bleeding into the spinal canal after surgery (a haematoma). If an event of this nature were to occur, every effort would be made to reverse the situation by returning to theatre to wash out the haematoma. Sometimes, however, paralysis can occur as a result of damage or reduction of the blood supply to the nerves or spinal cord and this is unfortunately not reversible;
- **a stroke, heart attack or other medical or anaesthetic problems**;
- and extremely rarely, **death**, as a result of damage to major blood vessels around the spine, which is reported as happening in 1 out of 10,000 cases; or
- **general anaesthetic fatal complications** which have been reported in 1 out of 250,000 cases.

Anterior discectomy – specific risks and complications:

- **bleeding in the wound and swelling in the windpipe** (laryngeal oedema), which could result in difficulty breathing or swallowing. This is rare but if it occurs, it may be necessary to take you back to theatre to try to stop the bleeding;
- **bone graft / cage / artificial disc movement** can occur in up to 2 out of 100 cases, with 1 out of 100 requiring re-operation. In extremely rare cases movement can cause severe damage and paralysis;
- **damage to the trachea (windpipe) or oesophagus (food pipe).** This is reported in fewer than 1 in 100 cases;
- **injury to the small nerve that supplies the vocal cords.** This can happen because of the retraction during the procedure and can cause temporary (or rarely, permanent) hoarseness of the voice. Retraction of the oesophagus can produce temporary difficulty and discomfort with swallowing. It is advisable to eat 'soft' food for a few days to help with this; and
- less than 1 in 100 patients can experience a **droopy eyelid** due to temporary stretching of a small nerve (sympathetic chain). This is not usually obvious and nearly always recovers.

ACDR versus ACDF – specific advantages and complications

The theoretical **advantages** of an artificial disc compared to fusion surgery are:

- maintains some neck movement;
- reduces 'increased load' on the adjacent disc and subsequent degeneration; and
- eliminates the potential complications and issues associated with bone graft.

The theoretical **disadvantages** of an artificial disc compared to fusion surgery:

- the mechanical device could wear out after a period of time (much like a hip or knee replacement) but there is currently no evidence to say when or if this will happen;
- further surgery may be necessary if the artificial disc wears out. This is likely to be fusion surgery;
- maintaining some movement will enable the 'normal' degeneration of the spine and arthritis in the cervical facet joints to occur at some point in time, as before surgery;
- success and safety of this surgery is reliant on excellent bone quality to maintain the position of the artificial disc. Therefore people with conditions such as osteoporosis may not be suitable for it; and
- it is not suitable for patients who have any degree of degeneration (arthritis) in the neck.

Factors which may affect spinal fusion and your recovery

There are a number of factors that can negatively impact on a solid fusion following surgery, including:

- smoking;
- diabetes or chronic illness;
- obesity;
- malnutrition;
- osteoporosis;
- post-surgery activities (see note of recreational activities); and
- long-term (chronic) steroid use.

Of all these factors, the one that can compromise fusion rate the most is smoking. Nicotine has been shown to be a bone toxin which inhibits the ability of the bone-growing cells in the body (osteoblasts) to grow bone. Patients should make a concerted effort to allow their body the best chance for their bone to heal by not smoking, ideally 2–3 months before the operation. Your surgery may be delayed if you have not stopped smoking (or taking nicotine in another form) beforehand.

What to expect after surgery and going home

Immediately after the operation you will be taken on your bed to the recovery ward where nurses will regularly monitor your blood pressure and pulse. Oxygen will be given to you through a facemask for a period of time to help you recover from the anaesthetic. You will have an intravenous drip until you can drink again after the surgery.

A drain (tube) will be placed near the surgical incision to prevent any excess blood or fluid collecting under the wound. It is also likely that you will be sitting up in bed immediately after the operation as this will help to reduce any swelling in your neck. The drain will be removed by the nursing staff when the drainage has stopped, usually the next day after surgery.

It is very normal to experience some level of discomfort or pain after the surgery. The nursing and medical staff will help you to control this with appropriate medication. The symptoms in your arms may fluctuate due to increased swelling around the nerves. As the nerves become less irritated and swollen, your pain should slowly start to settle. This can take up to eight weeks, or longer. It is important not to suddenly stop taking certain pain relief medication, such as morphine, or neuropathic medication (gabapentin, pregabalin or amitriptyline). It will be necessary to gradually 'wean' yourself off them – your GP can advise you if necessary. The ward physiotherapist will visit you after the operation to teach you exercises and help you out of bed. They will show you the correct way to move safely. Once you are confident and safely mobile, you will be encouraged to practise climbing stairs with the physiotherapist if this is appropriate. Once you are safe enough to manage at home you will be discharged, usually the next day after surgery but this may need to be longer.

Please arrange for a friend or relative to collect you, as driving yourself or taking public transport is not advised in the initial stages of recovery. If you qualify for patient transport and are likely to require this service, please let one of the nurses know as soon as you can, as this may need to be pre-arranged. Your discharge home could be delayed if not.

Wound care

Skin wound closure depends on your surgeon's preference and includes absorbable sutures (stitches), removable sutures or clips (surgical staples).

If you have removable sutures or clips, you will be advised by the ward nurse when to arrange an appointment with your GP's practice nurse for them to be removed.

If you have absorbable sutures, you will be advised by the ward nurse whether you need to make an appointment with your GP's practice nurse to have a wound check or when you can take off the dressing yourself.

You may bath or shower 48 hours after surgery if you are careful but you must avoid the dressing getting too wet. Most dressings used are 'splash-proof' but if water gets underneath, then it will need to be changed. A simple dry dressing from a pharmacy is sufficient to use. When shaving, care should be taken to avoid the area until it is fully healed.

Please contact your hospital or your GP if you think your wound might be infected. Symptoms could include:

- redness around the wound;
- wound leakage; or
- high body temperature.

Once the wound has healed and if the scar is sensitive to touch, you can start to massage around the scar using a non-perfumed cream or oil to encourage normal sensation and healing.

Driving

Normally you will be advised to avoid driving for 2–4 weeks depending on your recovery and individual situation. If you have no altered sensation or weakness in your arms and you can move your head around freely, then you may resume driving if you feel safe to do so but you must be confident to do an emergency stop. It is advisable not to travel for long distances initially (no longer than 20 minutes) without taking a break to move about.

Recreational activities

It is important to keep as mobile as you can after surgery, so get up and move about regularly (every 20 minutes or so). Walking outside is fine but increase your walking distances gradually and be careful not to trip over when on uneven ground. You will be advised to avoid lifting anything heavy, certainly for the first few weeks but maybe as long as three months after your operation.

Try to avoid stretching and reaching up above your head for the first few weeks after surgery, as this can cause nerve irritation and persistent arm pain which can slow down your recovery.

Please check with your consultant and physiotherapist when you are able to resume specific activities such as swimming or golf, as the advice could range from between six weeks to three months. A graduated return to sport is the advisable. Your surgeon may advise you to avoid flying for six weeks (and long-haul flights for up to three months) because of the increased risk of deep vein thrombosis (DVT) after surgery.

Work

Returning to work is dependent on both your recovery and your job. Most people are off work for an initial 3–4 weeks but if you are in a strenuous job you may need up to eight weeks. It is always sensible to discuss with your employer if you can return on 'light duties' and reduced hours at first. There is usually nothing to stop you doing computer/office work at an earlier date provided you can keep moving about. The hospital will issue you with a fitness to work (off work) certificate or you may ask your GP.

Follow-up

Your surgeon will advise you when you should attend clinic after your operation. If you have any queries about the information in this booklet, please discuss them with the ward nurses or a member of your consultant's team.

What is the British Spine Registry (BSR)?

The British Spine Registry aims to collect information about spinal surgery across the UK. This will help us to find out which spinal operations are the most effective and in which patients they work best. This should improve patient care in the future.

The Registry will enable patient outcomes to be assessed using questionnaires. These will allow surgeons to see how much improvement there has been from treatment.

This has worked for hip and knee joint replacements through the National Joint Registry. We need your help to improve spinal surgery in the UK.

What data is collected?

Your personal details allow the BSR to link you to the surgery you have had. They also allow us to link together all the questionnaires you complete. If you need any further spinal surgery in the future, details of previous operations will be available to your surgeon.

Personal details needed by the BSR are your name, gender, date of birth, address, email address and NHS number.

Your personal details are treated as confidential at all times and will be kept secure. This data is controlled by the British Association of Spine Surgeons (BASS) and held outside the NHS. Personal details will be removed before any data analysis is performed, retaining only age and gender. Your personal data and email address will not be available to anyone outside BASS

and its secure IT provider. Anonymised data may be released to approved organisations for approved purposes, but a signed agreement will restrict what they can do with the data so patient confidentiality is protected.

Your personal data is very important, as this will allow us to link details of your diagnosis and surgery with any problems or complications after surgery. You may also be asked to complete questionnaires before and after surgery to work out how successful the surgery has been. This will only be possible if we can connect you to the questionnaires through your personal details.

Do I have to give consent?

No, your participation in the BSR is voluntary and whether you consent or not, your medical care will be the same. Your personal details cannot be kept without your consent. This will be obtained either by asking you to physically sign a consent form or electronically sign one through an email link to a questionnaire or at a questionnaire kiosk in the outpatient clinic.

You can withdraw your consent at any time or request access to your data by:

- going to the patient section of the BSR website at www.britishspineregistry.com; or
- writing to us at the BSR centre (see address on next page). Please state if you are happy for us to keep existing data but do not want to be contacted, or whether you want your data to be anonymised (so it cannot be identified).

Research

Your consent will allow the BSR to examine details of your diagnosis, surgical procedure, any complications, your outcome after surgery and your questionnaires. These are known as ‘service evaluations’ or ‘audits’.

Operation and patient information, including questionnaires in the BSR, may be used for medical research. The purpose of this research is to improve our understanding and treatment of spinal problems. The majority of our research uses only anonymised information which means it is impossible to identify individuals. From time to time, researchers may wish to gather additional information. In these cases we would seek your approval before disclosing your contact details. You do not have to take part in any research study you are invited to take part in and saying no does not affect the care you receive.

All studies using data from the Registry will be recorded on the BSR website at www.britishspineregistry.com

Children

Parents are asked to consent for data to be collected from their child. Looking at the outcome of spinal surgical procedures is just as vital in children as it is in adults.

Further information

The BSR website at www.britishspineregistry.com contains more information, including details of any studies and any information obtained through the Registry data.

To contact the BSR, write to:

The British Spine Registry
Amplitude Clinical Services
2nd Floor
Orchard House
Victoria Square
Droitwich
Worcestershire
WR9 8QT

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Designed and illustrated by
Design Services at East Suffolk and North Essex NHS Foundation Trust.

DPS ref: 03372-18(RP)