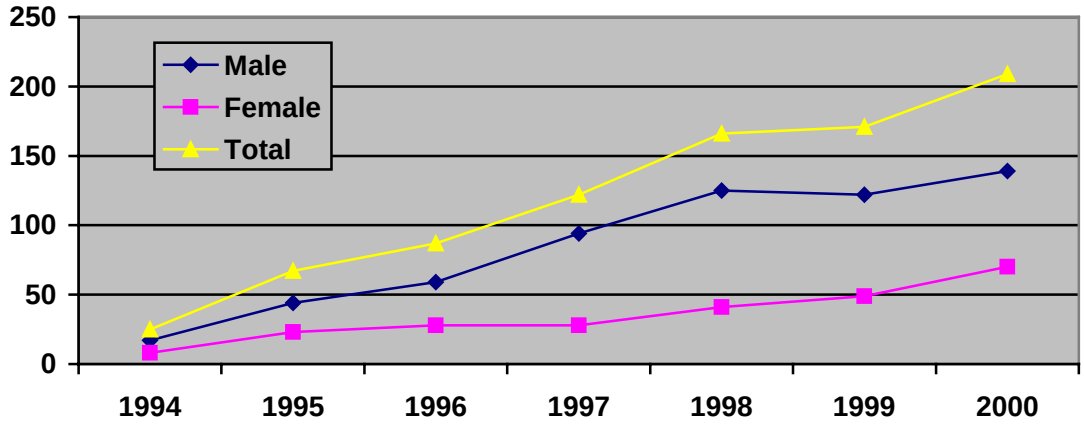
SPINAL INJURY

In Liverpool Hospital from 1994 up until the year 2000, a total of 847 patients with spinal injuries were admitted. The graph below shows that spinal injuries are increasing and that almost double the number of males are admitted with spinal injuries than females.



In Australia during 1998/99, 113 (43%) spinal cord injuries were sustained in transport accidents, 39 (23%) in falls, and the remainder resulted from other mechanisms such as diving injuries. Vehicle roll-over, collision with a roadside hazard (like a pole or fence), and ejection from a vehicle were the transport accidents most likely to lead to spinal injury. The latter statistics refer to **spinal cord** injury, not **spinal** injury. The difference will be explained in this document.

What is a spinal injury? What is a spinal cord injury?

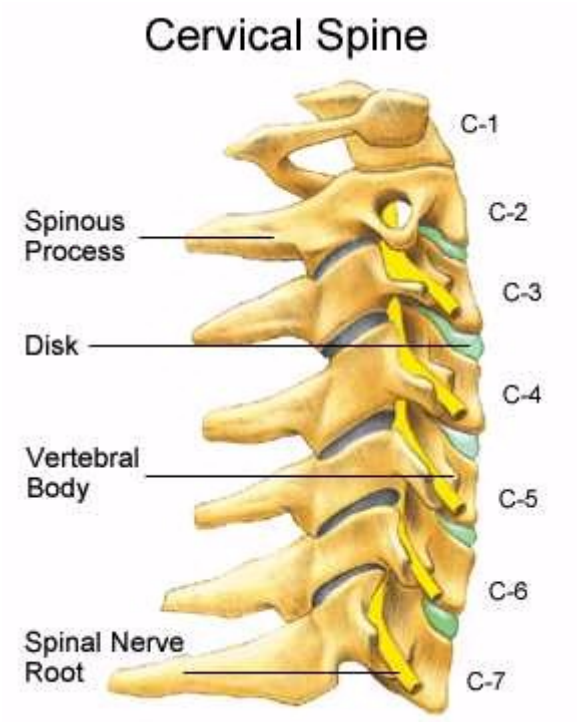
A spinal injury is any injury to the spinal column. This includes the vertebrae (bones), the supporting ligaments and the spinal cord (nerves). Spinal cord injury is injury to the nerves that travel down the spine. Spinal injury can occur without an injury to the spinal cord but it is very rare for the spinal cord to be injured without injury to the bones or ligaments.

ANATOMY (Where and what is it?)

The spine is made up of bones (vertebrae), discs, ligaments and the spinal cord. The spinal column has 33 vertebrae, which are divided into the cervical (7), thoracic (12), lumbar (5), sacral and coccygeal regions. The spine extends from the base of the brain down to the coccyx (the tail-bone). The bones provide protection for the spinal cord and vertical stability when upright. Between each vertebra is a disc of cartilage, which acts as a shock absorber. The ligaments link and support the bones. The spinal cord, like the brain, is surrounded by the meninges, which are layers of tissue that have some fluid between them and protect the spine. Injuries occur in patterns depending on exactly how the trauma occurred – the mechanism of injury.

Each vertebra has a spinous process, and these are the only parts of the spine that can be felt from the outside. Run your hand up and down the centre of your (or someone else's) neck and back. The bony bumps under the skin are the spinous processes. These are the rear part of each vertebra, which also has transverse processes and a body (see the picture below).

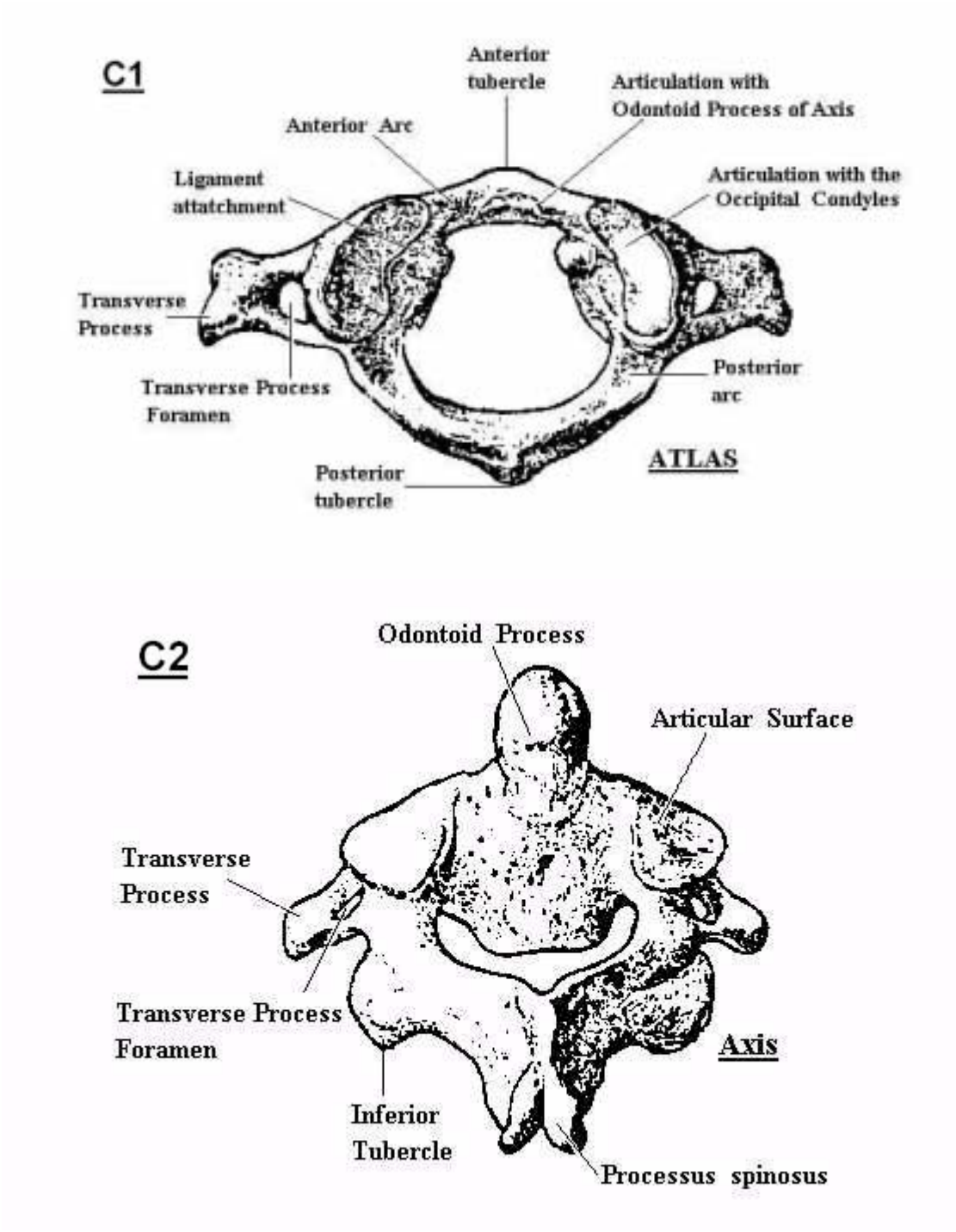
The body of a vertebra is thick, and provides the weight bearing structure for the spinal column. Coming off the body are the pedicles and lamina, which join to create an arch that surrounds the spinal cord.



Cervical Spine

The cervical spine consists of seven vertebrae and makes up the spine in the neck. Put your chin on your chest (stop if it's sore) and feel the back of your neck - one bony point protrudes further than the rest. This is the spinous process of your seventh cervical vertebra (also referred to as C7).

The top two cervical vertebrae are different from the others. The first vertebra is known as C1, or the atlas. This vertebra supports the weight of the head. C2, or the axis, has an appendage known as the dens, odontoid process or peg. The joint between these two vertebrae allows the head to move on the neck and turn sideways, nod and tilt. The pictures below show how C1 sits on C2 with the peg fitting into the first vertebra allowing a swivel action. The cervical spine is the most mobile region of the spine, which is why the majority of spinal injuries occur in the neck.



Thoracic Spine

The thoracic spine has twelve vertebrae. These bones form the spine for the chest and upper abdomen and each one has a pair of ribs attached. These vertebrae are larger and stronger than cervical ones as they carry more weight. The rib cage means that the thoracic spine is much less mobile than the cervical spine.

Lumbar Spine

There are 5 lumbar vertebrae, and these vertebrae are the biggest and strongest bones of the spine as they take the most weight. The lumbar spine is often called the lower back, and pain here is referred to as lumbago. Like the cervical and thoracic vertebrae, the lumbar ones are numbered from the top down.

Sacrum and Coccyx

The sacrum is shaped like a triangle, and is five vertebrae fused into a single bone. The sacrum is the rear part of the pelvis.

The coccyx, or tail-bone, is also triangular in shape. The final four vertebrae are fused into one. The coccyx can be felt between the top of each buttock.

The Spinal Cord

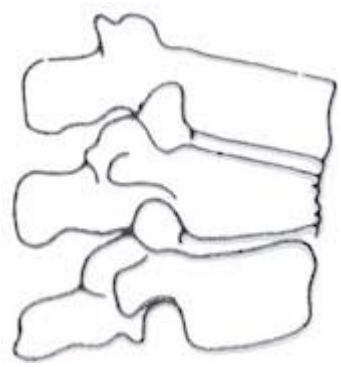
The spinal cord runs from the base of the skull to L1 or 2 in the adult and further in children. It contains nerves carrying information to the brain and instructions back. The cord is shaped like a cylinder and nerves leave it at each vertebra to supply a different area of the body. The cord is covered by the three meninges, which also cover the brain. These layers are the dura mater, the arachnoid and the pia mater. The space between the arachnoid and pia mater is called the subarachnoid space. This space contains cerebrospinal fluid (CSF). The fluid is normally clear and colourless, and is manufactured within the brain before flowing down around the spinal cord.

Types of Spinal Fractures

There are some fractures (breaks) that can occur to almost any vertebra (spinal bone). A list of some of these fractures can be found below.

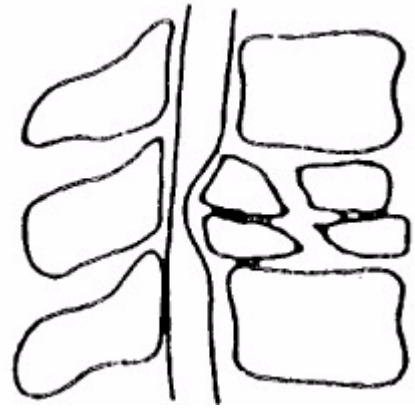
Simple fracture – these are fractures (breaks) that are commonly only a chip, or a crack in the bone. These types of fractures do not usually require treatment and are “stable” because if weight is put through the vertebra, it will not slip but maintain position and will not potentially injure the spinal cord.

Wedge or compression fracture – this type of injury is seen after car accidents and falls. The spine is compressed in a fall and compressed and bent forward over the seat belt in a car crash. The front part of the bone is compressed but the rear part stays intact forming the wedge. These injuries may sometimes need an operation but usually the break is stable and no treatment other than pain relief and rest is needed.



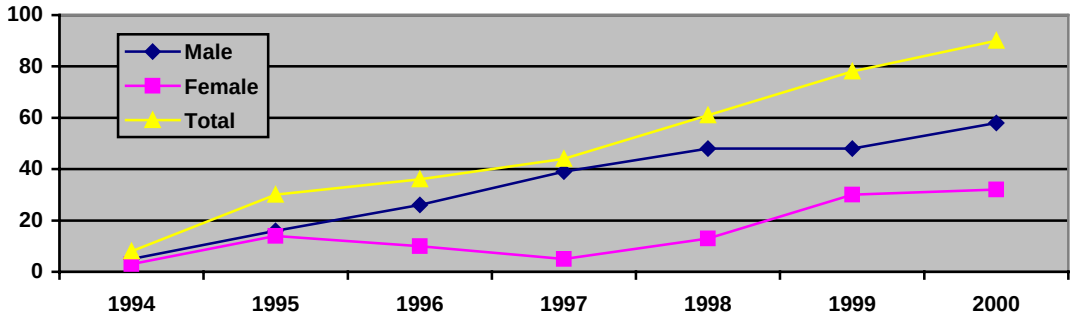
This is an example of a wedge fracture. See how the left hand side (the posterior part of the vertebrae) is uninjured, but the right hand side (the anterior part of the vertebrae) has been squashed down.

Burst fracture – this injury results from a vertical shearing force. Examples include diving into a shallow pool head first, a heavy weight falling on your head, or falling from a height and landing on your feet. The bones are overloaded and one or more vertebral bodies bursts open. Fragments can be pushed into the canal where the spinal cord is. These fractures are not stable and require treatment.



This is an example of a burst fracture. See how it is not just the front that has been damaged, but it is the whole section of vertebrae in front of the spinal cord. This demonstrates how this kind of injury can have more serious consequences than the wedge fracture above.

CERVICAL SPINE INJURY



This graph shows the patients admitted from 1994 to 2000 with a cervical spine injury. As you can see, the numbers admitted with a cervical spine injury have increased ten times over the seven years.

Common Causes – the neck is the most mobile part of the spine and the most vulnerable to injury especially when forcibly flexed or extended. The common causes of this are car accidents and falls. If the ambulance crew suspect a neck injury, they will put a collar on the patient – see picture. The collar does not keep the head and neck completely still, so blocks may be put either side of the head and taped in place. In most cases, this is just a precaution, and is used to keep the neck from moving until it can be proved that there is no injury.

Diagnosis - x-rays are the initial method of diagnosis. Three views are taken to assess the spine from different angles. Sometimes these views do not show the bottom of the cervical spine where it joins the thoracic spine and extra pictures are needed. A CT scan uses x-rays to build up cross-sections of the spinal column. This gives the doctors more information to determine if there is an injury and whether the cord is threatened. Magnetic Resonance Imaging (MRI) is another investigation that gives good information on the spinal cord itself compressing the spinal cord.

Treatment – this depends on the type of injury. If the fracture is stable an operation is not required and treatment will be a softer supportive collar and pain relief. Physiotherapy will also help. Unstable fractures require more active treatment. An operation can fix the bones in place and maybe needed to reduce pressure on the spinal cord. Other options that the neurosurgeons will consider include wearing a stiff collar for a few months, or halo traction.

Halo traction is provided by screwing pins into the skull. These attach to metal rods that also attach to a vest, which is worn like a jacket. The apparatus is continuously worn for around 3 months until the bones have healed. Another method of applying traction is using Gardener-Wells tongs. These consist of a semi-circle of metal that sits above the head. The tongs are screwed into the skull by pins (one on each side of the head above the ears), and then the

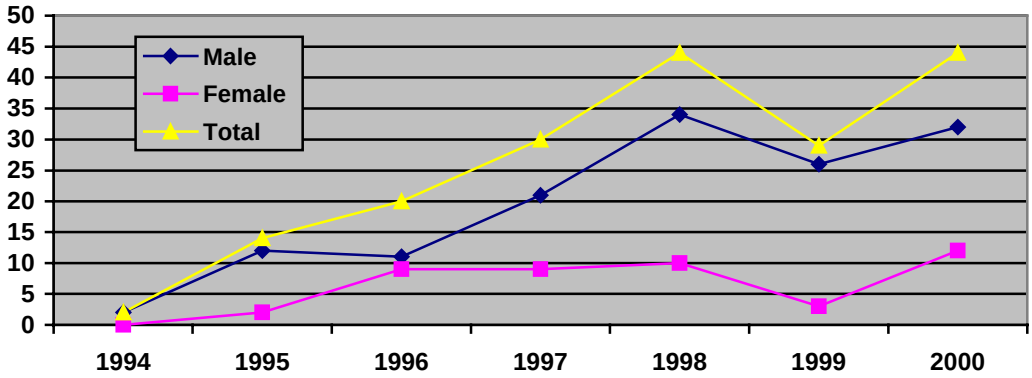
metal piece is attached to the weight and hung over the side of the bed so that traction can be applied. This straightens out the neck, allowing the fracture to heal without injuring the spinal cord or supporting structures.

Complications - The largest problem with cervical spine injury is damage to the spinal cord. The closer the injury to the brain, the greater the consequences of spinal injury. An injury to the spinal cord at the top of the cervical spine is likely to be fatal.

Outcome – this is specific to the whether the spinal cord is damaged and the level where this has happened. If the cord is not involved recovery is good although some patients may be left with some stiffness and neck pain. If the cord is severed injury to the top 3 vertebrae is fatal as the nerves controlling breathing will be cut. Cord injury at C4 will result in breathing difficulties and paralysis in all 4 limbs - quadriplegia. If the spinal cord at C5 is injured, the patient will have partial shoulder and elbow movement, but will otherwise be paralysed. The patient with cord damage at C6 will be able to use shoulders and elbows and have partial wrist movement but no use of their hands and their legs. Injury at C7 allows shoulder, elbow, wrist and some hand movement. A large part of treatment is rehabilitation to maximise a patient's remaining function and allow as much independence as possible.

THORACIC SPINE INJURY

The thoracic segment is the least mobile portion of the spine and supports the rib cage. These factors mean that it is least often injured. The graph shows that despite this the number of people admitted to Liverpool Hospital with injury to the thoracic spine is increasing.



Common Causes - falls from height, landing on the feet or buttocks: car crashes.

Diagnosis – the primary mode of diagnosis are x-rays. Other investigations that may assist in the diagnosis of thoracic spine injury are CT and MRI scans.

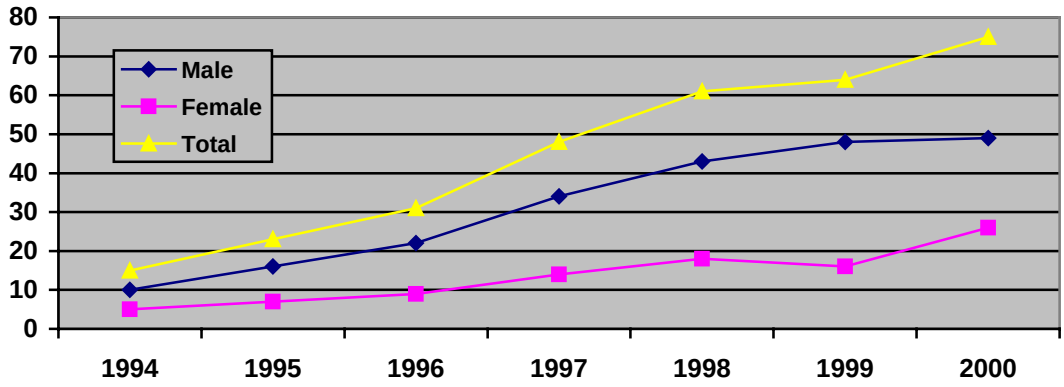
Treatment - A large percentage of thoracic spine fractures are “stable”, due to the support of the rib cage, and need pain relief, physiotherapy and gentle mobilisation. Unstable fractures may need an operation, a period of bed rest or a plaster brace. This latter assists in stabilising the spine and allows the patient to get up and move around. The plaster is usually left on for 6 weeks to 3 months, depending on the healing bone.

Complications - the spinal cord continues down through the thoracic spine and can be injured at any level. Damage at T1 will affect hand movements as well but injury lower down will result in paraplegia. The lower the injury the more sensation around the torso will be retained.

Outcomes – stable fractures heal well but there may be residual stiffness and pain. Spinal cord injury from the thoracic region results in paraplegia and rehabilitation and specialised help will be needed.

LUMBAR SPINE INJURY

The lumbar spine takes the heaviest load and is more mobile than the thoracic spine. This results in a higher incidence of injury as shown in the graph.



Common Causes - car crashes; falls from height landing on the feet or buttocks. If a back seat passenger is only wearing a lap strap, in a crash the lumbar spine can be bent over the strap causing a fracture.

Diagnosis - x-rays will determine the presence and nature of a fracture. CT or MRI scans can be used to further clarify the exact injury and any other damage.

Treatment - again is specific to the injury. Stable fractures can be managed without intervention. Unstable fractures may need an operation, bed rest or a brace.

Complications - the spinal cord ends at the level of L1 or 2 in the adult (lower in children). After this point the remaining nerves travel down the spinal canal individually. The appearance of the nerves gives this area its name - the cauda equina or horse’s tail. Cord injury with paraplegia can still occur at L1 or 2 but below this level there is more room in the spinal canal for the nerves.

Nerve injury is therefore rare and isolated to individual or small groups of nerves. This can still be severely debilitating.

Outcome – stable fractures with no cord or nerve damage will heal well. Some stiffness and lower back pain can remain. Injury to the highest lumbar vertebrae may result in spinal cord injury and a resultant paraplegia. Injury to the lower vertebrae may result in entrapment of nerve roots of the cauda equina, and may require an operation.

SACRAL-COCCYGEAL SPINE INJURY

Common Causes - Injuries to the sacrum and coccyx are rare. The sacrum forms the rear of the pelvis and is therefore well protected. In pelvic trauma, the sacrum may become dislocated from the bones it is joined to but is rarely broken. Injuries to the coccyx bone are almost exclusively a result of falling directly onto the buttocks, or as a result of giving birth.

Diagnosis - this is established with an x-ray, however, CT scanning may also assist in locating injuries.

Treatment - bed rest and pain relief is all that is usually needed. An operation is rarely required.

Complications – damage to nerves in the sacrum can lead to bowel, bladder and sexual dysfunction.

Outcome - dependent upon the initial injury, there may be some loss of function requiring rehabilitation. Most injuries will do well with some residual pain and stiffness.

SPINAL CORD INJURY

The spinal cord can be injured without fractures or other abnormalities visible on x-ray. This is Spinal Cord Injury Without Radiological Abnormality (SCIWORA). It is very rare but more frequent children than adults as their spines are more mobile and bendy. Injury to the spinal cord is more often the result of injury to the spinal column. The damaged bones cutting off the space in the spinal canal and crushing the cord.

When the cord is injured there will be swelling. The nerves of the cord will stop working and the patient becomes paralysed. If the damage is incomplete, the cord is not permanently affected and as the swelling goes down, the nerves will start to function again. If the damage is complete, there is little chance of recovery.

The closer to the brain the damage to the spinal cord is, the poorer the outcome. If the cord is severed just below the brain, it is fatal. Damage to the cervical spinal cord results in quadriplegia, and injury to the thoracic and lumbar spinal cord results in paraplegia.

Common Causes - Common causes of spinal cord injury are broken vertebrae being driven into the cord, or dislocations of the vertebrae, causing compression of the cord preventing nerves from conducting impulses.

Diagnosis – this begins with examination for clinical signs and symptoms. Patients, who have altered, reduced or absent sensation or power in any or all limbs, will be assumed to have a spinal cord injury until proven otherwise. The signs and symptoms will dictate the investigations that are needed to show or exclude an injury and determine further treatment.

Treatment – on arrival, immediately life-threatening conditions will be sought, treated and stabilised first. At Liverpool there are three neurosurgeons and an orthopaedic surgeon who provide initial care for spinal injuries. Long term rehabilitative care for patients with spinal cord injury is very specialised requiring extensive facilities, which are not available here. After initial stabilisation and treatment, the small group of patients needing further rehabilitation will be transferred to a spinal unit.

Complications - there are many potential problems with spinal cord injury. If the injury is high in the cervical region the patient may not be able to breathe without assistance, although this will often have been fatal at the time of the accident. A tracheostomy tube in the neck into the trachea (windpipe) allows artificial ventilation of the lungs. Other potential complications of spinal cord injury are pneumonia and breakdown of skin, as patients cannot move around, and feel pain when they sit or lie in the same position for too long.

Outcome – the final outcome depends on the level of injury, and whether the damage was complete or not. Complete injuries will not recover as there is transection (severing) of the cord. Incomplete injuries only affect some of the cord and may regain some or all function. The aim of rehabilitation is to maximise recovery, abilities and independence.

COMMON INVESTIGATIONS AND TREATMENTS FOR SPINAL INJURIES

X-ray – the most common investigation for suspected spinal injury. This will show bony damage but not actual cord injury.

CT Scan – x-rays are used to build up cross-sections of the body with a computer. CT scans are used to support and give further detail to the x-ray findings, assisting diagnosis and treatment plans.

MRI Scan – another form of scanning without x-rays, MRI provides doctors with additional information about the injury has had on the spinal cord.

Collars – hard collars are used for to immobilise a patient's neck when an injury is suspected. Patients given a collar by ambulance personnel or on arrival at hospital do not necessarily have a broken neck. These collars are placed as a precaution in all patients until it is shown by examination and x-rays that there is no spinal injury. Other collars may be used later to support

the neck during recovery – these collars are more comfortable than the hard collar.

Theatre - an operation maybe required to stabilise a fracture. The type of injury that has occurred determines the method of fixation. There are several systems in use by surgeons but the operation may involve inserting metal plates and screws to support the injured spinal column.

Bed Rest and traction devices – other treatment options that allow the fracture time to heal. Types of traction have been included in individual sections above.

BETTER PRACTICE GUIDELINES

Better Practice Guidelines are available on a number of health related issues. These guidelines are compiled with the assistance of expert advice and research on the topics under scrutiny.

There is a collection of practice guidelines from various international sources of chest injury. One such guideline is from Eastern Association for the Surgery of Trauma (EAST) in the USA and refers to cervical spine management.

COMMON QUESTIONS

Does everyone who has a spinal injury develop paralysis?

No. Only a small percentage of patients who have a spinal injury have a cord injury and resultant paralysis. Most patients either require no operation, or have an operation and go home with no other symptoms, and return to their pre-injury capabilities.

What is quadriplegia?

Quadriplegia is permanent loss of movement and sensation from the neck down. Patients have varying but limited use of the arms and some have problems with breathing. All lose bladder and bowel control.

What is paraplegia?

Paraplegia is a permanent loss of movement and sensation function below the mid-chest. Patients have the ability to move their upper body, including head, neck, arms and hands but have lost bladder and bowel control.

FACILITIES AT LIVERPOOL HOSPITAL

Ward

The Neurosurgical ward is a 30 bed ward that has a staff ratio of one nurse to five patients. The phone number for the ward is (02) 9828 3123.

Social Worker

Liverpool Hospital has social worker facilities provided throughout the duration of hospital stay. A social worker is alerted to the arrival of a trauma patient in the Emergency Department, and will provide any necessary assistance.

For the rest of the hospital stay, social work cover and help is available in Intensive Care, the ward and the Brain Injury Unit. Social workers will also assist in the completion of Workcover and sick entitlement forms.

LINKS, ORGANISATIONS AND SUPPORT GROUPS FOR SPINAL INJURY

Osteomyelitis

This site provides information including pictures relating to bone regrowth and treatment of complications. The provider is based in Atlanta.
www.osteomyelitis.com

Spinal Cord

This site provides information about rehabilitation, books, and many other topics.
www.spinalcord.uab.edu

Health at Yahoo

Health at Yahoo provides a dictionary, so that you can put in any term, at it will give answers that are easy to understand.
www.health.yahoo.com

Spinetrust
Spinetrust is an Australian site, devoted to finding a cure for paralysis. The site has local numbers of people injured, and other interesting facts and figures.
www.spinetrust.com.au

Paraquad

Paraquad is based in Victoria, Australia. It is a site that provides local resources, and support, and items can be bought over the Internet. It also has information on injuries.
www.paraquad.asn.au

Spinal Cord

This is an American based site that goes into detail regarding spinal injury and rehabilitation.
www.spinalcord.org

Australian Quadriplegic Association

The creators of this site are based in Sydney, Australia. There is lots of information about spinal cord injury and support available on line and over the phone from this site.
www.aqa.com.au