A PHOTOGRAPHIC GUIDE TO PREHOSPITAL SPINAL CARE

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INDEX

TABLE OF CONTENTS

INTRODUCTION

INTRODUCTION

Each year in Australia, approximately 240 persons suffer traumatic spinal cord injuries (**SCI**). Currently a total of 12,000 persons live in Australia with SCI, at a cost to the Australian community of A$500 million per year for the long term ongoing care of these patients.

The management of the potential spinal patient in the prehospital setting requires a range of skills including scene management, safe work practices, hazard control, patient assessment and treatment.

This manual - used in conjunction with the three day 'Prehospital Spinal Management' course - is designed to develop a systematic approach to multiple aspects of prehospital spinal care.

TERMINOLOGY

Prehospital personnel (including Paramedics, First-aiders, Rescue Officers and other persons performing activities in the prehospital setting) will for standardisation, all be referred to as '**Officer/Officers**' throughout this manual.

Spinal cord injury will be abbreviated to '**SCI**' throughout this manual.

TRAINING

Officers should realise that there is no substitute for training and experience, thus all Officers must be thoroughly trained in all areas of prehospital spinal management.

The ideal situation is to have all Officers in the team qualified to manage all the steps presented in this manual. If unqualified Officers are present at a scene, they must perform under strict supervision of a qualified team Officer.

Frequent exercises need to be held to ensure that training levels are maintained. Practice will lead to a high level of competence and safety.

It is recommended that initial training of Officers is to include, but is not limited to:
1. Review of this instruction manual.
2. A minimum of 3 applications of each procedure presented in this manual in a training environment under direct supervision of an appropriately trained supervisor before use on actual patients.

It is recommended that ongoing training of Officers is to include, but is not limited to:
1. Three monthly practical review of each procedure presented in this manual in its intended environment,
2. Twelve monthly theoretical & practical review of each procedure.

Officers using this manual without proper initial & ongoing training may place the patient and themselves at risk of injury, including permanent SCI of the patient.

EQUIPMENT

Officers must be familiar with all items of equipment they use, the way the equipment operates and the equipment's limitations. Every Officer should be competent to check and maintain equipment in the field.

COURSE MANUAL

This course manual is written for Officers who have previous first aid knowledge. It is designed for Officers with a minimum Level Two - Workplace First Aid Course.

ADDITIONAL COPIES OF THIS MANUAL

This manual can be downloaded at no charge under the copyright conditions on page two of this manual as a 9.5 PDF file from the Emergency Technologies website at www.emergencytechnologies.com.au/psm.htm.

The manual is best printed in colour.

There is no limit to the number of copies a person and / or organisation may print, nor to the distribution of the PDF file under the copyright conditions stated on page two of this manual. The copyright does prohibit photocopies of this manual being made. This is to ensure that only high quality copies are available.

USING THIS MANUAL

This manual offers the reader a detailed photographic guide into the management of the potential or actual SCI.

The manual is designed to be used in conjunction with a proper spinal management course, and should not be used in isolation.

The instructions supplied in this manual are for use only by properly trained Officers and serve as a guideline only.

If any conflict exists between information presented in this manual and your organisations protocols, follow your Medical Directors' recommendations.

SPINAL CORD INJURY STATISTICS

SPINAL STATISICS

The following are a range of spinal cord injury (SCI) statistics recorded for the financial year of July 2001 to June 2002 by the Australian Institute of Health & Welfare.

AUSTRALIAN SPINAL INJURY UNITS

Australia has six hospitals that care for SCI patients. These are located in the following five States:

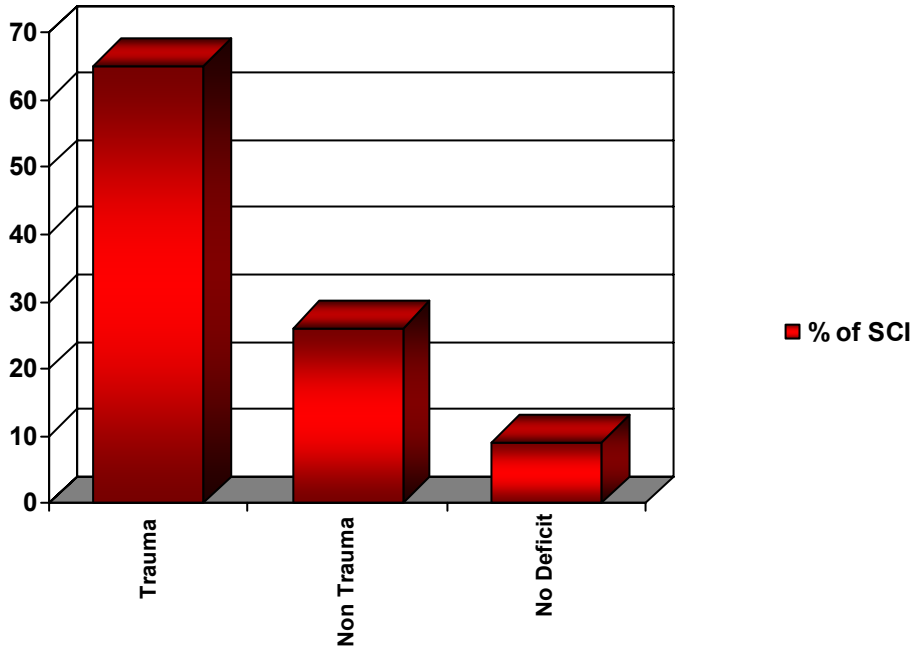
- Queensland (Princess Alexandra Hospital)
- NSW (Royal North Shore Hospital & St James Hospital)
- Victoria (Austin Hospital)
- South Australia (Royal Adelaide Hospital)
- Western Australia (Royal Perth Rehabilitation Hospital)

Tasmania, Northern Territory and the A.C.T. do not have Spinal Units and SCI patients are sent to the closest interstate Spinal Unit.

NUMBER OF SCI PATIENTS

In Australia for the period July 2001 to June 2002, there were 375 SCI patients recorded.[2] Of these approx:

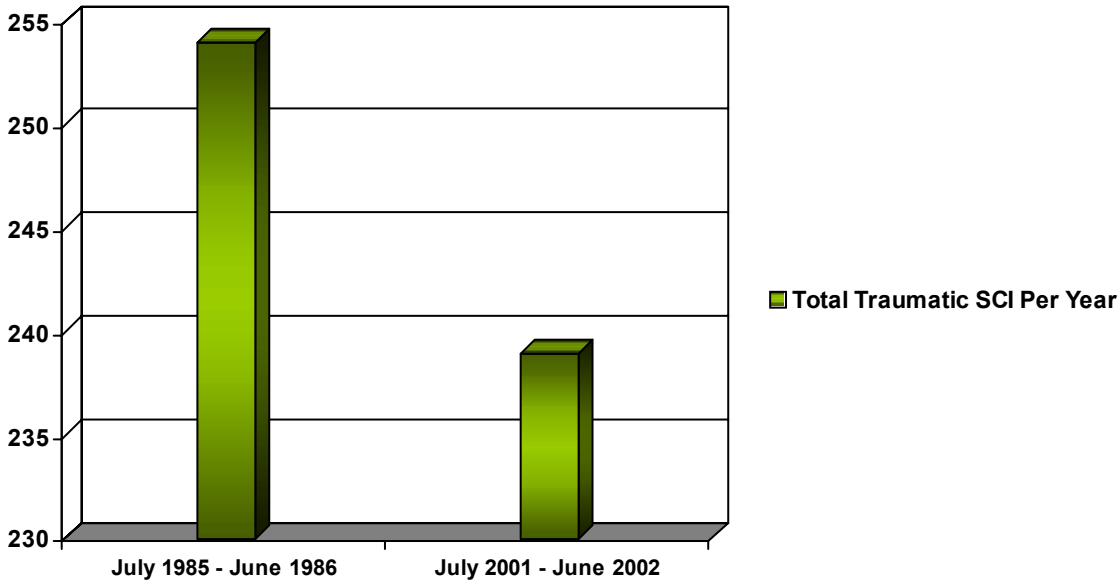
- 239 were of a traumatic nature,
- 102 were from non traumatic causes including tumours and spinal surgery,
- 34 showed initial evidence of SCI or spinal cord concussion, but made a full recovery without any remaining SCI.

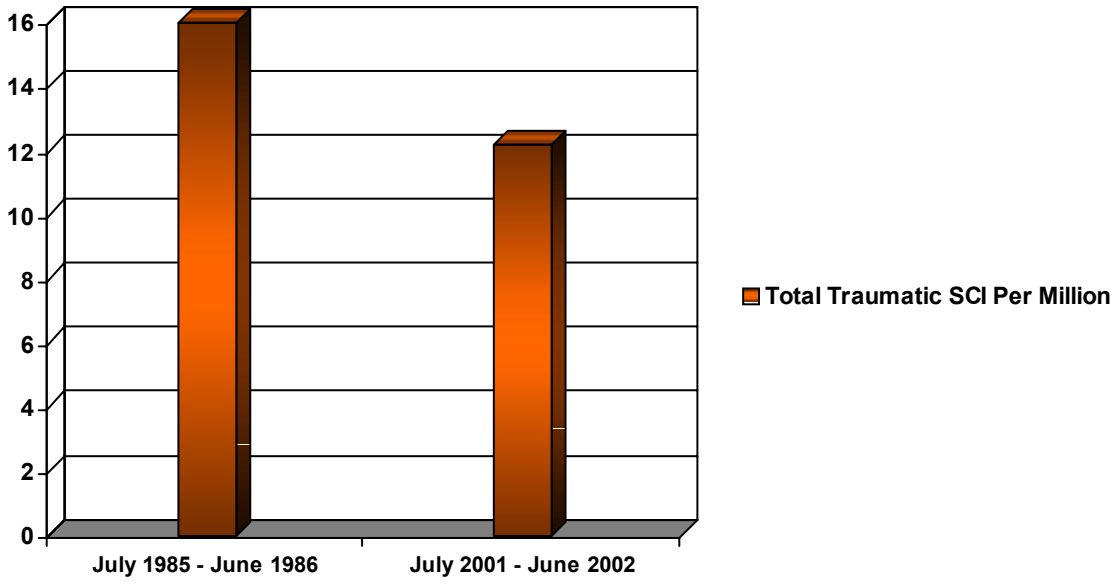


PREVALENCE OF TRAUMATIC SCI

The recorded number of SCI (caused by trauma) each year has been on a slight decrease. However there is statistically significant decrease in the recorded number of SCI (caused by trauma) per million population.

In the period July 1985 to June 1986, traumatic SCI patients numbered 254 (or 16 per million population)[1] whilst in the period July 2001 - June 2002, traumatic SCI patients numbered 239 (12.2 per million population).[2] This excludes children under 15 years of age as figures for this age group are not reliable.



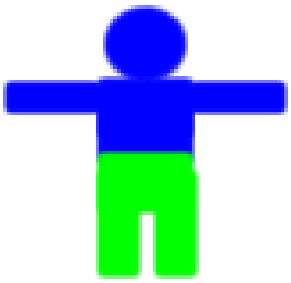


LEVEL OF SCI

In Australia for the period July 2001 - June 2002, 54% of traumatic SCI was at the tetraplegic level.[2]

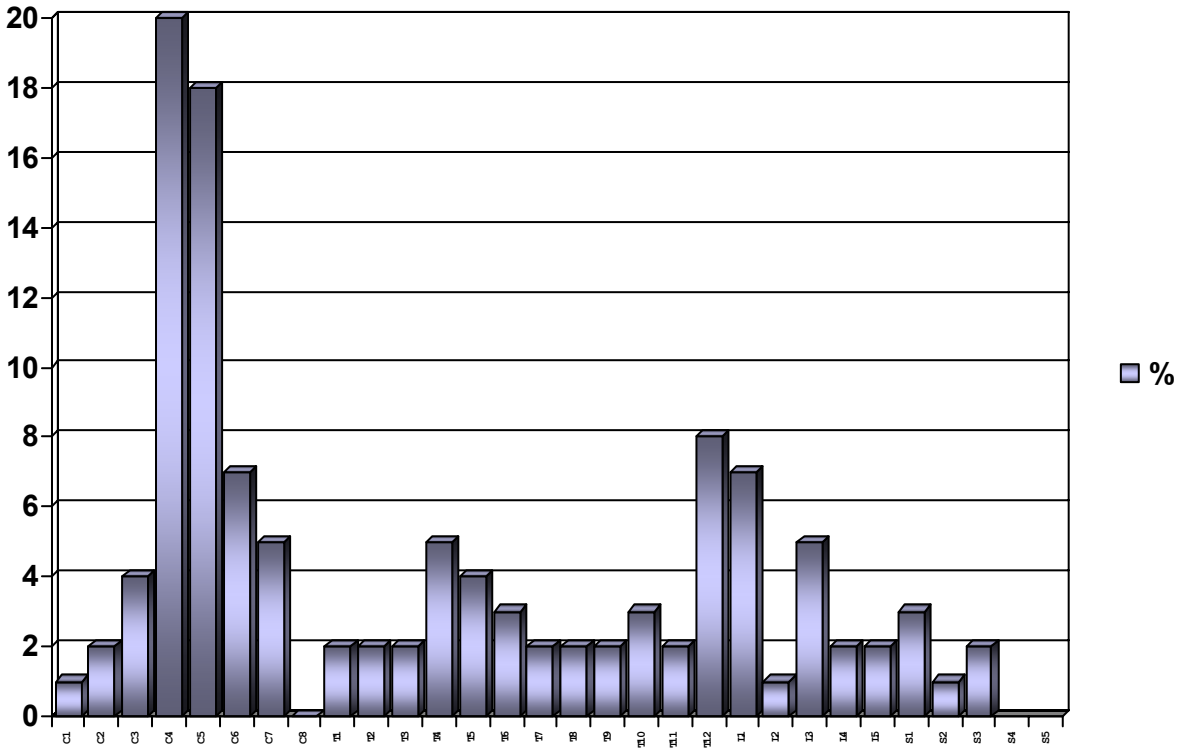
Tetraplegia (also called quadraplegia) refers to impairment or loss of motor or sensory function in the cervical segments of the spinal cord. At this level, arms and legs are affected.

The remaining 46% of traumatic SCI for the period July 2001 - June 2002 was at the paraplegic level.[2]



Paraplegia refers to impairment or loss of motor or sensory function in the thoracic, lumbar or sacral segments of the spinal cord. At this level, the SCI patient will still have arm function.

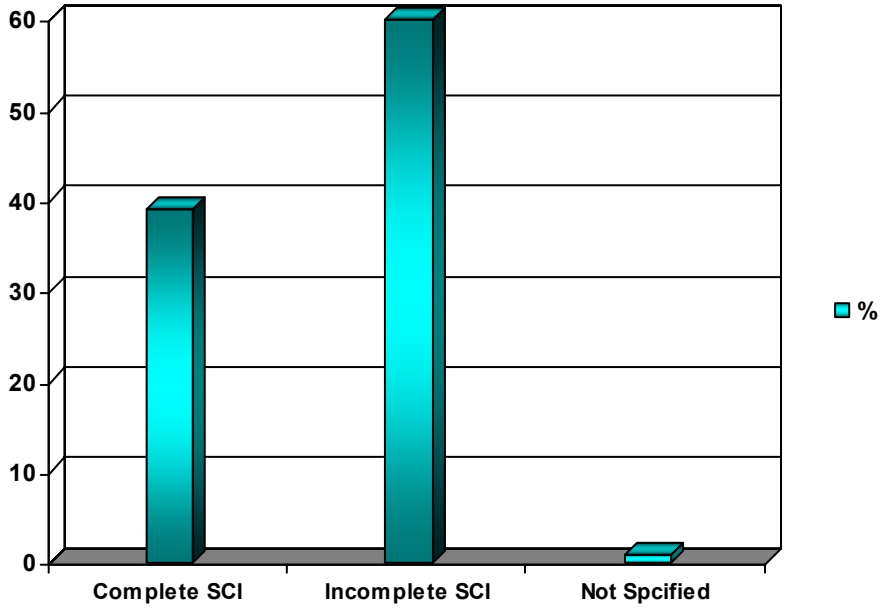
The following graph depicts the % distribution of levels of traumatic SCI for the period July 2001 - June 2002.[2] The most common levels remains at the C_{4-5} levels, followed by the T_{12} to $L_{3.}$ These figures are generally unchanged from year to year.

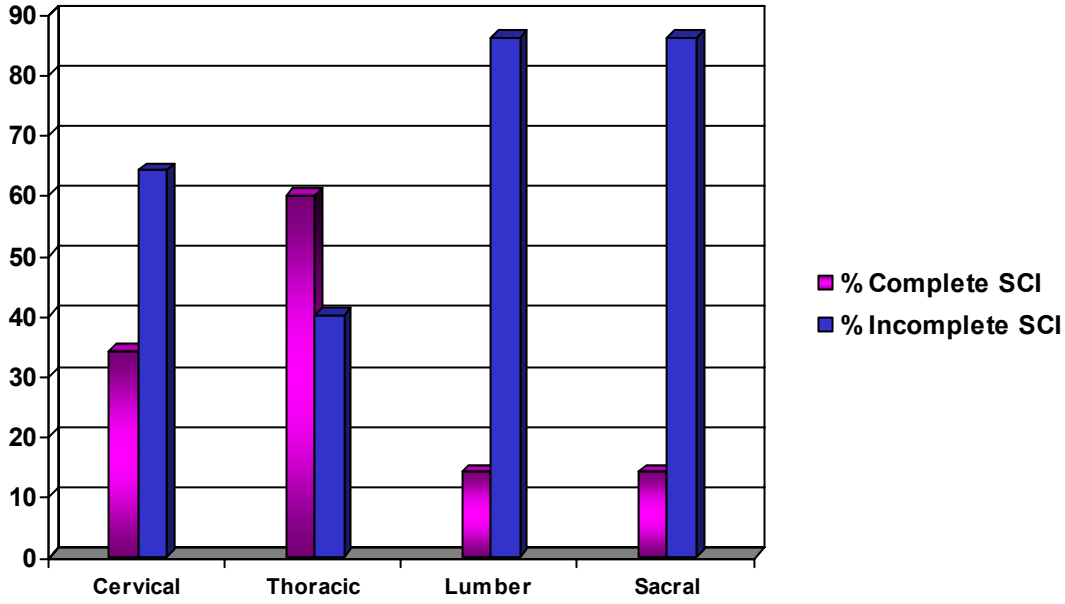


EXTENT OF SCI

The majority of traumatic SCI are incomplete injuries, that is there is some function of either motor or sensory function below the level of the SCI. Complete SCI refers to complete absence of motor and sensory function below the level of SCI.

In the period July 2001 - June 2002, thoracic injuries were complete (60% of cases) due to the small diameter of the spinal canal, whilst only 34% of cervical injuries and 14% of lumbar & sacral were complete. With poor management, incomplete injuries can progressively worsen.[3-4]





CAUSES OF SCI

The most common cause of traumatic SCI for the period July 2001 - June 2002 related to road usage, with motor vehicle crashes accounting for 59 (25%) of the 239 SCI patients, the majority of these SCI being at the cervical level 37 (63%). Approximately 31 (53%) of these SCI were incomplete injuries.

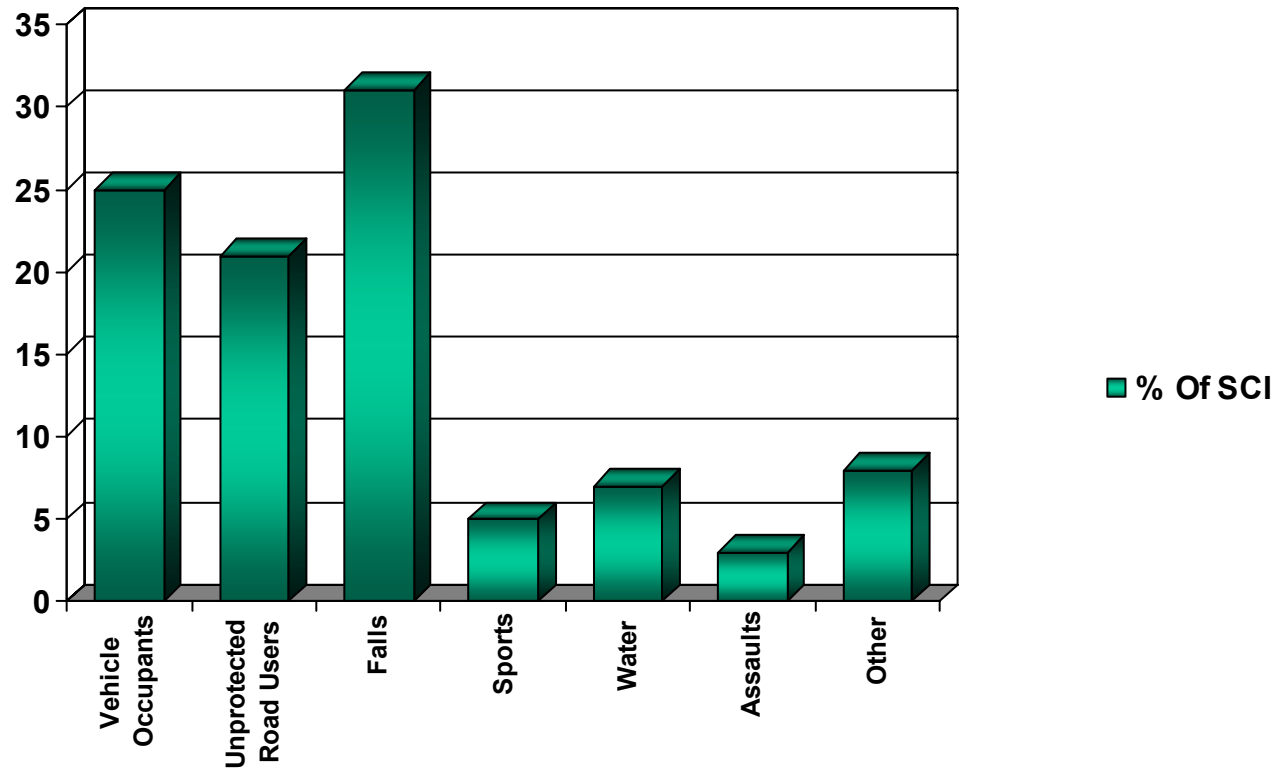
Unprotected road users refers to motorcycle riders, cyclists and pedestrians, and accounted for 54 (21%) of all traumatic SCI. The major area of injury in these cases (57%) were at the thoracic level or below of cases. Again 28 (53%) of these SCI were incomplete injuries.

Falls accounted for 73 (30%) of the 239 traumatic SCI. Interestingly, falls from a height below 1 m accounted for 30 (41%) of the 73 traumatic SCI. Mechanisms of injury guidelines[5] alone would have failed to identify these patients and therefore the guidelines need reviewing. This statistic was commonly repeated in previous years as well.

Water sports accounted for 16 (7%) of the 239 traumatic SCI. All these injuries were at the cervical level. Causes included diving (9 cases), surfing (4 cases), and other (5 cases).

Sporting injuries accounted for 13 injuries (5%) of the 239 traumatic SCI, with the most common being Rugby & Australian Rules football (8 cases all cervical), with the remaining 5 being snowboarding, skiing, parachuting and trampolining.

Other causes of SCI included animal attacks (3 cases), hit by a falling or other object excluding assaults (10 cases) and medical complications (2 cases).



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2. Australian Institute of Health & Welfare
   Spinal Cord Injury Australia 2001 - 2002

3. Toscano
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   Prevention of neurological deterioration before admission to a spinal Injury Unit

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   Clinical Practice Guidelines: December 2003

ANATOMY OF THE SPINE

ANATOMY OF THE SPINE

The Nervous System is made up of all the nerve tissue in the body including the brain, brainstem, spinal cord, nerves and ganglia. It is divided into two parts:

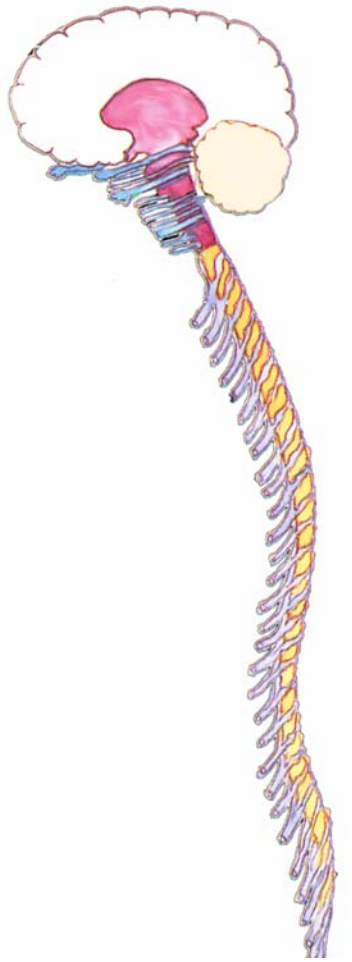
- **Central Nervous System (CNS).**
- **Peripheral Nervous System (PNS).**

CENTRAL NERVOUS SYSTEM

The Central Nervous System (CNS) is that part of the nervous system that consists of the **brain** and **spinal cord**.

The average adult human brain weighs 1.3 to 1.4 kg. The brain is thought to contain approximately 100 billion nerve cells (also known as **neurons**) and trillions of "support cells" called **glia**.

The spinal cord is approximately 43 cm long in the average adult female and 45 cm long in average adult male. It weighs approximately 35 to 40 gms. The spinal cord is protected by a series of structures including the vertebral column, muscles, ligaments, cerebral spinal fluid, and the meninges.



Brain & Spinal Cord

PERIPHERAL NERVOUS SYSTEM

The Peripheral Nervous System (PNS) is the nervous system found outside the spinal cord. Nerves in the PNS connect the CNS with sensory organs, other body organs, muscles, blood vessels and glands.

The PNS is divided into two major parts:

- **Somatic nervous system**
- **Autonomic nervous system.**

SOMATIC NERVOUS SYSTEM

The somatic nervous system is under voluntary control.

It consists of peripheral nerve fibers that send sensory information to the brain, and motor nerve fibers that send messages to the skeletal muscles.

AUTONOMIC NERVOUS SYSTEM

The autonomic nervous system looks after those neurons that are not under conscious control and regulates key functions, including the activity of the heart muscle, smooth muscles (e.g. abdomen), and the glands.

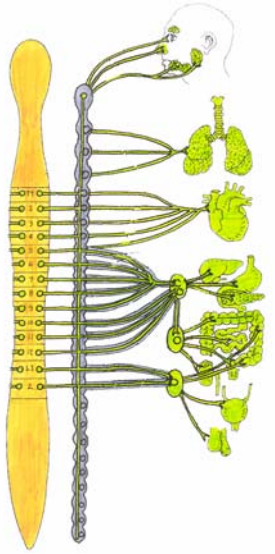
It is divided into two parts:

- **Sympathetic nervous system.**
- **Parasympathetic nervous system.**

SYMPATHETIC NERVOUS SYSTEM

The Sympathetic Nervous System is the system that involves the fight/flight responses of the body including accelerating the heart rate, constricting blood vessels, raising blood pressure, producing sweating, increasing blood supply to the muscles and accelerating respiration.

The Sympathetic Nervous System fibers come out of cell bodies in the spinal cord from T_1 to L_2 and secrete adrenaline & nor-adrenaline.

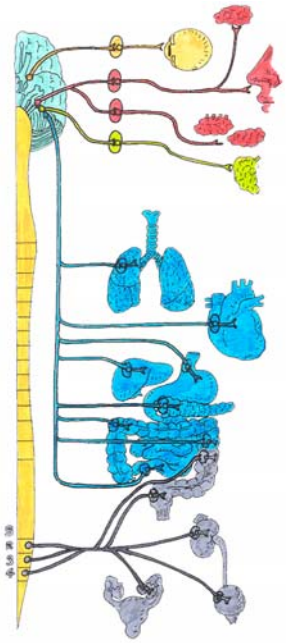


Sympathetic Fibres

PARASYMPATHETIC NERVOUS SYSTEM

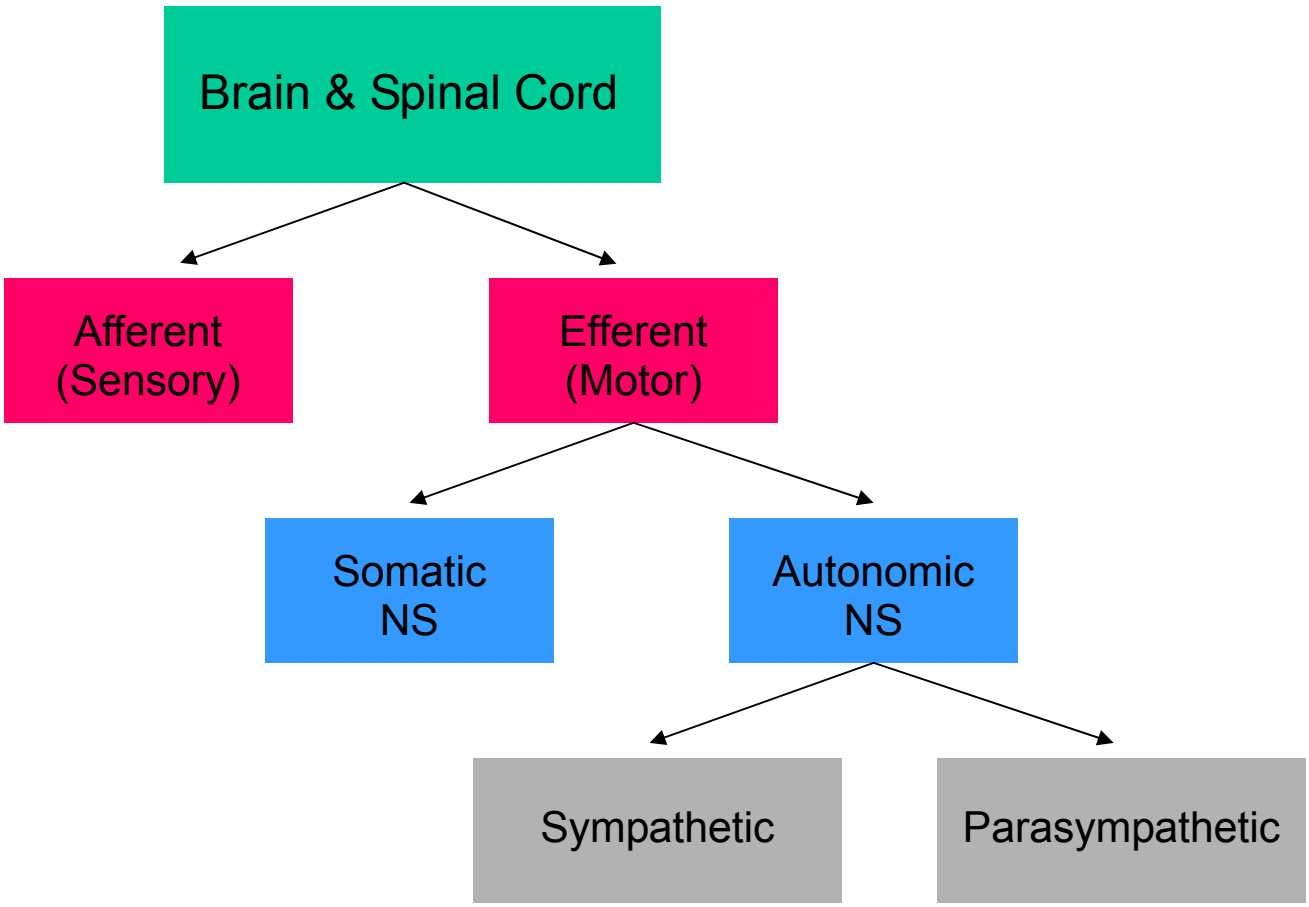
The Parasympathetic Nervous System is the system that slows down the body including slowing the heart rate, dilating the blood vessels, lowering blood pressure and slowing respiration.

The Parasympathetic Nervous System fibers come out of the cranial nerves 3, 5, 9 & 10, and from the spinal cord at the sacral levels of S_2 to S_4.



Paraympathetic Fibres

FLOWCHART OF THE NERVOUS SYSTEM



NEURONS

Cells of the nervous system are called nerve cells or **neurons**. These are the basic information processing unit of the nervous system, and are responsible for generating and conducting nerve impulses via a electrochemical process. The human brain has some 100 billion neurons. Neurons come in many different shapes and sizes. Some of the smallest neurons have cell bodies that are only 4 microns diameter (1 micron is equal to one thousandth of a mm). Some of the larger neurons have cell bodies measuring 100 microns diameter.

Neurons differ from other cells in the body because:

- Neurons have specialized extensions called **dendrites** (bringing information to the cell body) and **axons** (which take information away from the cell body).
- Neurons communicate with each other via an electrochemical process.

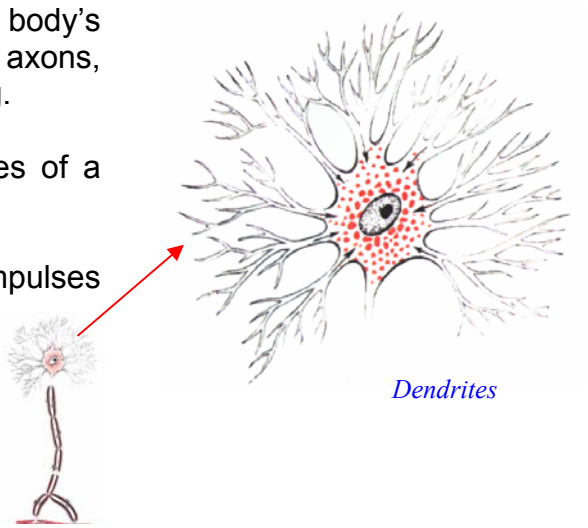
Neuron

DENDRITES

Dendrites are thread like extensions of the cell body's cytoplasm forming a tree like formation. Unlike axons, dendrites are not surrounded by any outer covering.

Dendrites comprise most of the receptive surfaces of a neuron.

The dendrites main purpose is to conduct nerve impulses towards the neuron's **cell body**.

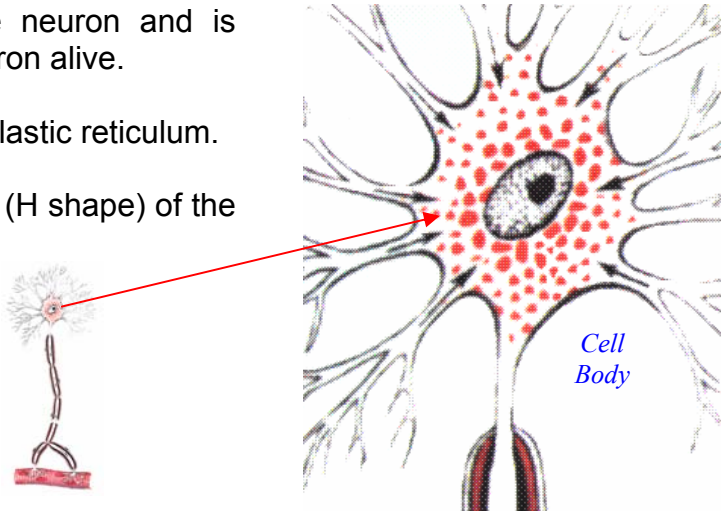


CELL BODY

The cell body is the main part of the neuron and is composed of substances to keep the neuron alive.

It consists of nucleus, cytoplasm & endoplastic reticulum.

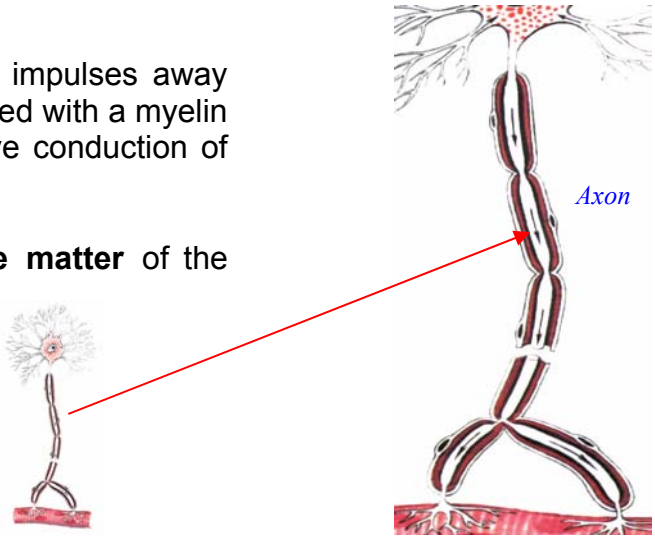
Cell bodies are found in the **grey matter** (H shape) of the spinal cord.



AXON

The axon's purpose is to conduct nerve impulses away from the cell body. Most axons are covered with a myelin sheath for axon protection and to improve conduction of the nerve impulse down the axon.

Myelinated axons are found in the **white matter** of the spinal cord.

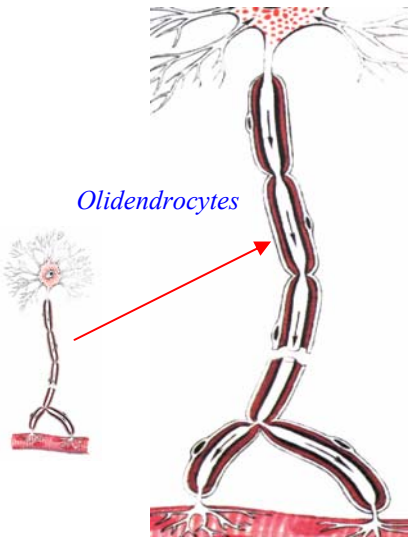


OLIGODENDROCYTES

Oligodendrocytes are a form of neuroglial cells (type of connective tissue) found in the CNS that form a myelinated wrapping around the CNS axons.

Oligodendrocytes surround neurons, providing both mechanical & physical support, and electrical insulation between neurons, dramatically increase the speed of conduction through the axon.

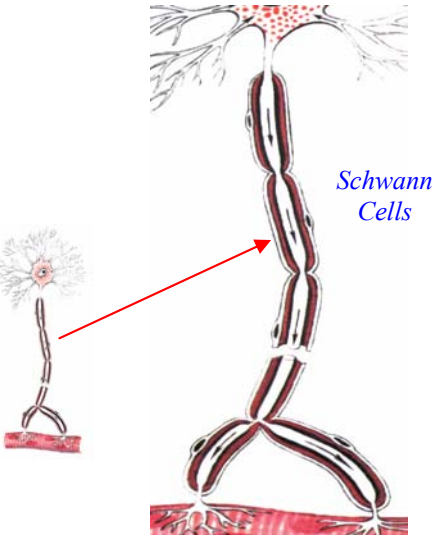
Oligodendrocytes form the white matter of the spinal cord.



SCHWANN CELLS

Schwann cells are a form of neuroglial cells found in the PNS that form a myelinated sheath wrapping around the PNS neuron's axons.

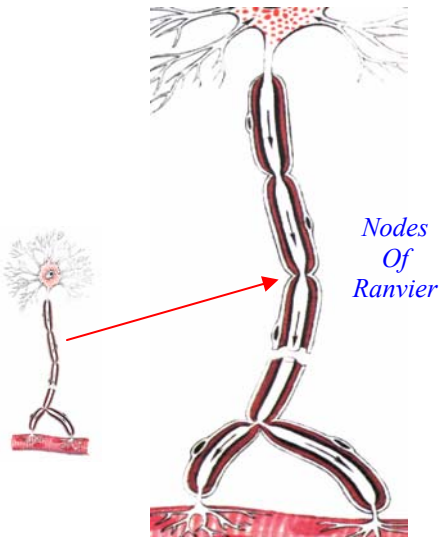
The purpose of this myelinated sheath is to provide an insulating layer surrounding the axon that dramatically increases the speed of conduction through the axon.



NODES OF RANVIER

Nodes of Ranvier are regions of exposed neuronal plasma membrane on a myelinated axon that occur every 1 - 2 cm down the axon.

The nodes contain very high concentrations of voltage gated ion channels and are the site of propagation of action potentials (which reduces the capacitance of the neuron), allowing much faster transmission of the nerve impulse down the axon.

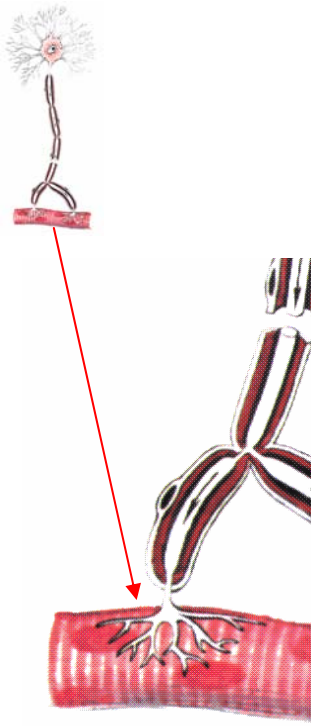


SYNAPTIC CLEFT

Communication from neuron to neuron, or neuron to muscle & sensory receptor (including pain, temperature and pressure receptors) occurs at the synaptic cleft, by a process called synapse.

The synapse process occurs by:

- An impulse moves down the axon to the synaptic knob.
- Calcium channels in the synaptic knob are stimulated and open allowing calcium to enter the synaptic knob.
- Calcium stimulates synaptic vesicles which move towards and fuse with the presynaptic membrane.
- Synaptic vesicles release neurotransmitter substances including acetylcholine (between nerves & skeletal muscle), nor-adrenaline and acetylcholine (between nerves & visceral organs) and a range of other substances (for neuron to neuron).
- Neurotransmitters pass across the synaptic cleft to the post synaptic membrane.
- The neurotransmitters combine with the receptors on the post synaptic membrane and if strong enough, stimulates an excitatory or inhibitory reaction.



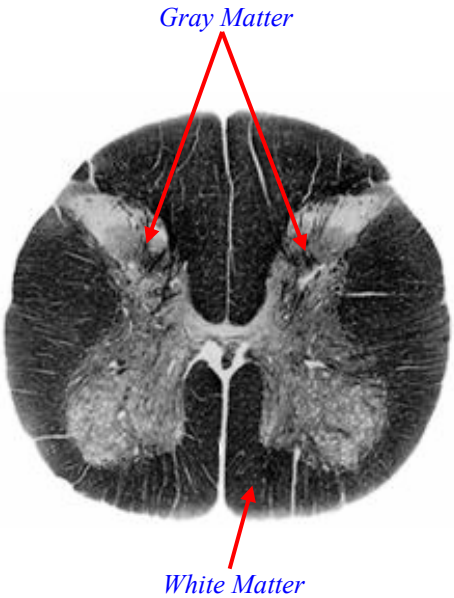
Synaptic Cleft

SPINAL CORD

The spinal cord is a bundle of neurons (approximately 13.5 million) that forms the main pathway for information connecting the brain and the peripheral nervous system.

The human spinal cord is about 43 to 45 cm long, 9 to 14 mm wide, and weighs approximately 35 gms. It is a continuation of the brainstem beginning at the foramen magnum and extending down to the last of the 2nd lumbar vertebra. Nerves that branch from the spinal cord at the lumbar and sacral levels must run in the vertebral canal for a distance before they exit the vertebral column. This collection of nerves in the vertebral canal is called the cauda equina (which means "horse tail").

The central grey matter of the spinal cord is made up of the nerve's cell body, dendrites and unmyelinated axons, with the white matter formed by the myelinated axons.



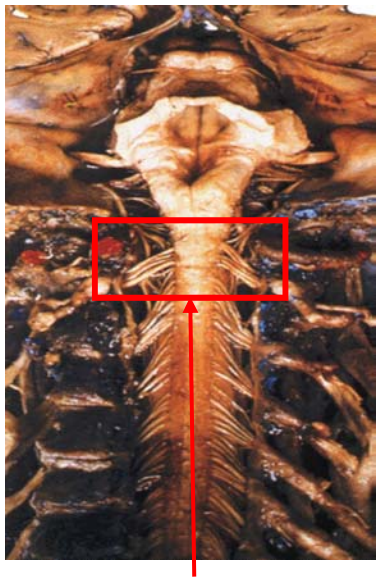
SPINAL NERVES

Spinal nerves are collections of axons of the peripheral nervous system.

A total of 31 pairs of spinal nerves emerge from the spinal cord which include:

- 8 Cervical.
- 12 Thoracic.
- 5 Lumbar.
- 5 Sacral.
- 1 Coccygeal.

The motor nerves leave the spinal cord anteriorly whilst the sensory nerves enter the cord posteriorly.



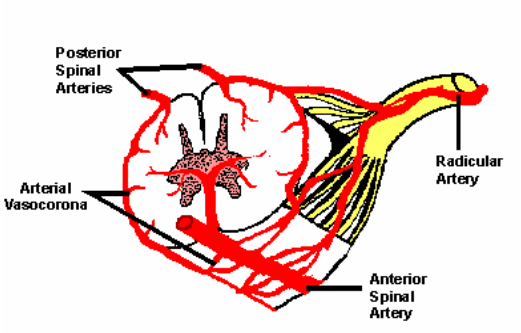
Spinal Segment

BLOOD SUPPLY TO THE SPINAL CORD

There are 3 arteries running the length of the spinal cord:

- One **anterior spinal artery** supplies the anterior two-thirds of the spinal cord.
- Two **posterior spinal arteries** supply the posterior one-third of the spinal cord.

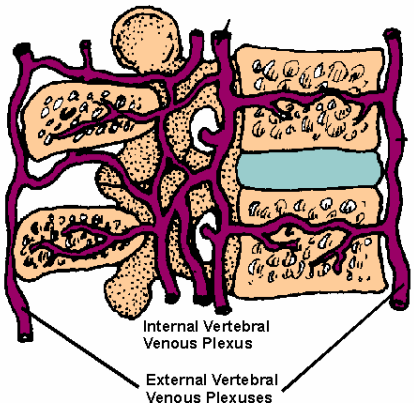
Additional arteries known as **segmental radicular arteries** enter the vertebral canal at the same points that spinal nerves enter and leave the spinal cord.



Spinal arteries

Veins run parallel with the arteries and are continuous with the venous drainage system of the brain.

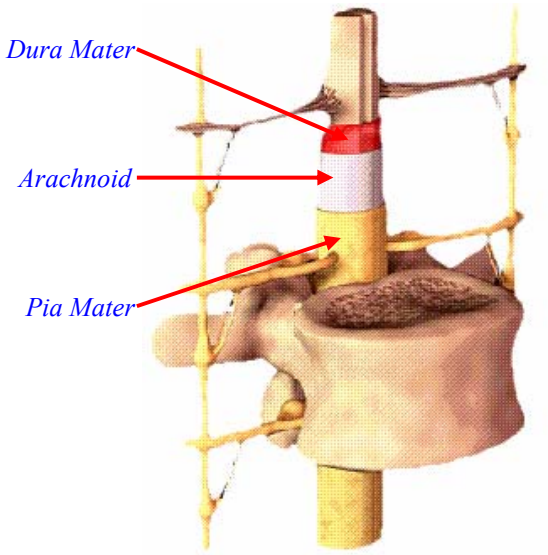
- The **internal vertebral venous plexus** are a group of spinal veins found both anterior and posterior (usually 3 of each) that drain into numerous radicular veins. These form a network of thin walled, valveless veins in the extradural (epidural) space draining the spinal cord.
- The **external vertebral venous plexus** surrounds the vertebral column and communicate freely with the internal vertebral venous plexus, also draining the spinal cord.



Spinal veins

MENINGES

The brain and spinal cord are surrounded by a protective lining known as the meninges which is designed to keep out infection.

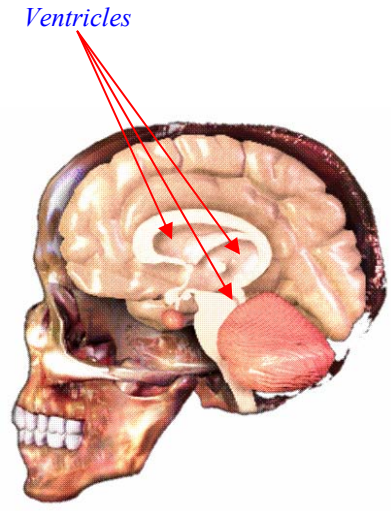


There are 3 layers of the meninges:

- **Dura Mater** forms the outer most layer. It is a tough, fibrous, tubular sheath that extends down to S_2 (even thought the spinal cord terminates at L_1-L_2).
- **Arachnoid** forms the middle layer. It is a delicate membrane sheath that also extends down to S_2.
- **Pia Mater** forms the inner layer. It adheres closely to the surface of the spinal cord, enclosing a network of blood vessels & gives rise to denticulate ligaments.

CEREBRAL SPINAL FLUID

Cerebral spinal fluid (CSF) is a clear odourless fluid produced from plasma by a structure (called the choroid plexus) in the lateral, third and fourth ventricles of the brain. CSF flows from the ventricles into the subarachnoid space. Approximately 100 mls of CSF flows around the brain and spinal cord.

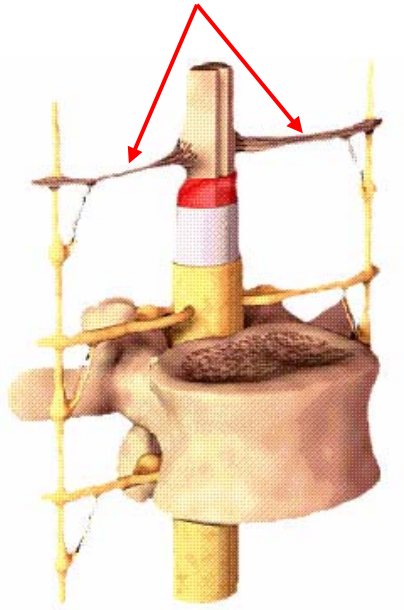


The CSF has four functions including:

1. **Protection**: the CSF protects the brain and spinal cord from damage by acting to cushion blows to the head and torso (to lessen the impact).
2. **Buoyancy**: because the brain is immersed in fluid, the net weight of the brain is reduced from about 1.4 kg to about 50 gm. Therefore, pressure at the base of the brain is reduced.
3. **Excretion of waste products**: the one-way flow from the CSF to the blood takes potentially harmful metabolites, drugs and other substances away from the brain.
4. **Endocrine transport throughout the brain**: the CSF transports hormones throughout the brain and spinal cord where they may act.

DENTICULATE LIGAMENTS

Denticulate Ligaments



The denticulate ligaments extend from the spinal cord at 21 points between nerve roots, to suspend the spinal cord within the dural sac.

These ligaments help prevent the spinal cord being knocked against the vertebrae during motion.

SPINAL COLUMN

The individual bones of the spinal column (also referred to as vertebral column) are known as the vertebrae.

The vertebrae provide significant protection and support to the spinal cord. Vertebrae also take the majority of the weight placed upon the spinal column.

There are 31 to 33 vertebrae that, when stacked on top of each other, create the spinal column. The variation in number of vertebrae is due to the fusing of the sacral and coccygeal vertebrae which numerous texts classify differently.

The normal spinal column forms an "S" like curve when looking at it from the side. This allows for an even distribution of weight. The "S" curve helps a healthy spine withstand all kinds of stress. The cervical section curves slightly inward, the thoracic section curves outward, and the lumbar section curves inward. Even though the lower portion of the spine holds most of the body's weight, each section relies upon the strength of the other sections to function properly.

The **body** of each vertebrae is a large, round portion of bone. The body of each vertebrae is attached to a bony ring. When the vertebrae are stacked one on top of each other, these rings creates a hollow tube known as the **spinal canal**, through which the spinal cord passes.

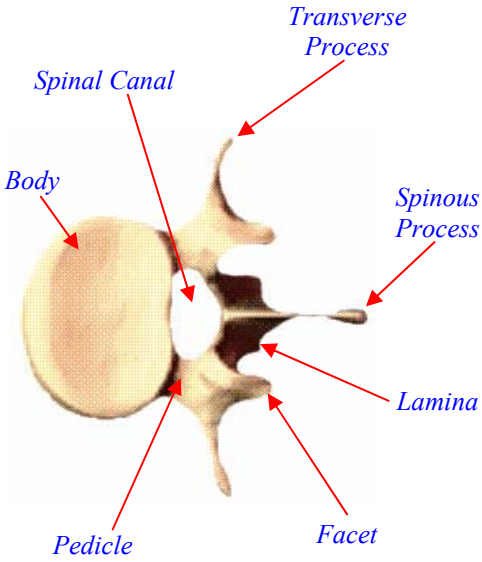
Spinal Column

VERTEBRAE

The vertebrae are the individual bones of the spinal column, and are made of a hard outer shell called cortical bone, with an internal component being soft and spongy cancellous bone.

The anatomy of the vertebrae consists of:

- The **Body** is the large round section at the front of the vertebrae and takes most of the weight placed on the spinal column.
- The **Spinal Canal** also known as the vertebral foramen, is where the spinal cord is located.
- The **Transverse Processes** are where the back muscles attach to the vertebrae.
- The **S63**
- **pinous Process** is the bony portion opposite the body of the vertebrae.
- The **Lamina** extends from the body to cover the spinal canal.
- The **Facets** connect each vertebrae together and allows the vertebral column to move.
- The **Pedicle** is a bony projection that connects to both sides of the lamina.
- The **Neural Foramen** is the opening between each pair of vertebrae where the nerve roots exit the spine.

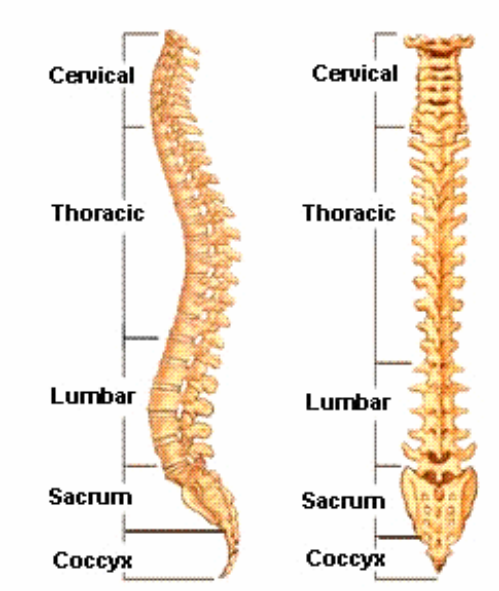


SPINAL SECTIONS

The spinal column is made up of 33 vertebrae, although some medical textbooks range from 27 to 33 due to the fused bones of the sacral and coccyxl sections.

The 5 sections of the spinal column are:

- **Cervical spine** (7)
- **Thoracic spine** (12)
- **Lumbar spine** (5)
- **Sacral spine** (5)
- **Coccyx spine** (4)



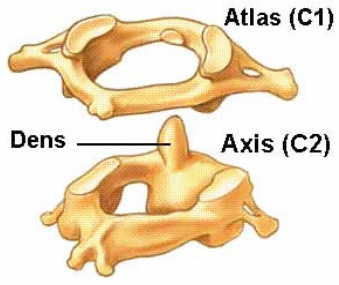
Sections of the spinal column

CERVICAL SPINE

The cervical section (also called cervical spine) consists of the first seven vertebrae of the vertebral column and is the most mobile of all the sections.

The first two vertebrae in the cervical spine, the **atlas** and the **axis** differ from the other vertebrae a they are designed specifically for significant rotation.

The cervical spine's shape has a lordotic curve. The lordotic shape is like a backward "C". Think of the spine as having an "S" like shape, and the cervical region being top of the "S".



Cervical spine

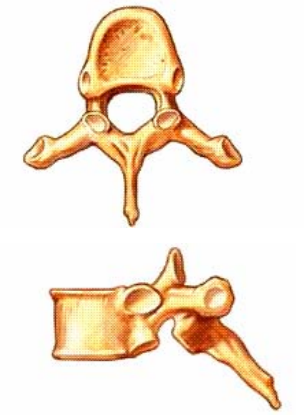
THORACIC SPINE

The thoracic section (also called thoracic spine) consists of the next 12 vertebrae of the spinal column.

Each thoracic vertebrae connects to ribs and form part of the posterior wall of the thorax (the rib cage area between the neck and the diaphragm).

This section of the spine has very narrow, thin intervertebral discs, therefore limiting movement between vertebrae in comparison to the lumbar or cervical sections of the spine. There is also less space in the spinal canal for the nerves.

The thoracic spine's curve is called kyphotic because of its shape, which is a regular "C" shaped curve with the opening of the "C" in the front.

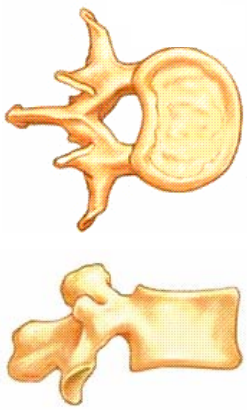

Thoracic spine

LUMBAR SPINE

The lumbar section (also called lumbar spine) consists of the next 5 (stubby) vertebrae. These vertebrae are the largest in the entire spinal column, and need to be as they carry two thirds of the body's weight. Thus the larger area of the spinal canal in each of the lumbar vertebrae allows more space for the spinal cord to move laterally.

The lumbar sections shape is similar to the cervical section in that it has a lordotic curve (a backward "C"). Remembering that the spinal column is an 'S' shape, the lumbar spine is the bottom of the "S". This lordotic curve is the result of walking and standing erect.

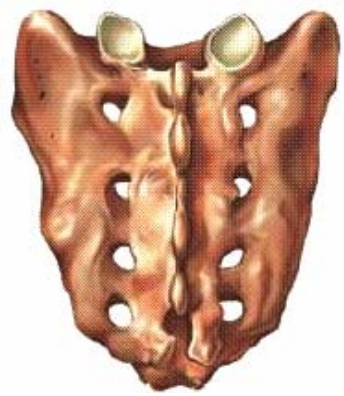
This group of vertebrae are very mobile and during bending takes 50% of the upper body weight (the other 50% by the hips). As a result, great pressure is placed onto the lumbar sections discs, often causing them to rupture in later life.


Lumbar spine

SACRAL SPINE

The sacral section (also called sacral spine) consists of the next 5 vertebrae (6 on rare occasions). These are fused together to form a single bone.

The sacral spine is joined to the pelvic girdle forming the posterior section of the pelvis. It transmits the weight of the body to the pelvis.



Sacrum

COCCYXL SPINE

The coccyxl section (also called coccyxl spine) consists of the final either 2 or 4 vertebrae. These are also fused together.

It has little purpose in homo sapien, but was once the vestigial tail of our forefathers.

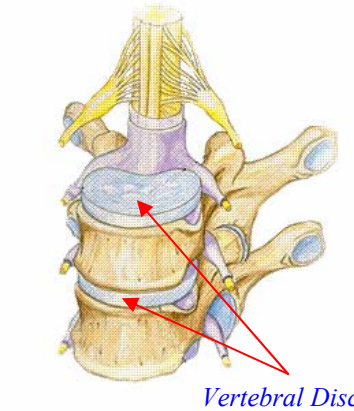
Coccyx

VERTEBRAL DISCS

A vertebral disc is found between each of the vertebrae from the cervical to lumbar.

The main purpose of each disc is to act as a shock absorber. Each disc also spreads stress placed on the spine, assists in movement between vertebrae and provides stability.

Each disc is composed of two parts, a tough outer coating and a softer inner substance (often described as a jelly donut). At birth, the discs are of a watery substance, that with age dehydrates to form a more jelly like substance.



Vertebral Discs

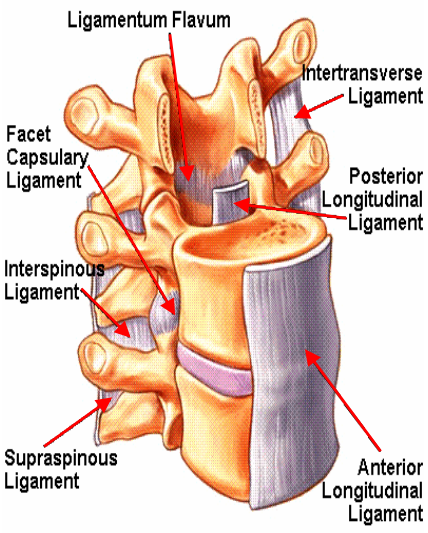
SPINAL LIGAMENTS

Spinal ligaments assist in providing structural stability to the spinal column. Two main ligament systems exist in the spinal column:

- **Intrasegmental systems**.
- **intersegmental systems**.

The intrasegmental system which includes the ligamentum flavum, interspinous and intertransverse ligaments join individual vertebrae together.

The intersegmental system consisting of the anterior longitudinal ligaments, posterior longitudinal ligaments, and the supraspinous ligaments. These join and stabilise large sections of the spinal column.

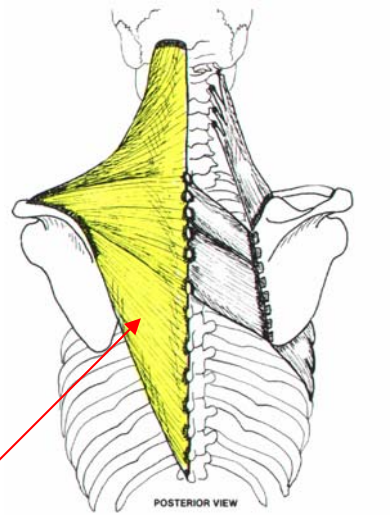


Spinal ligaments

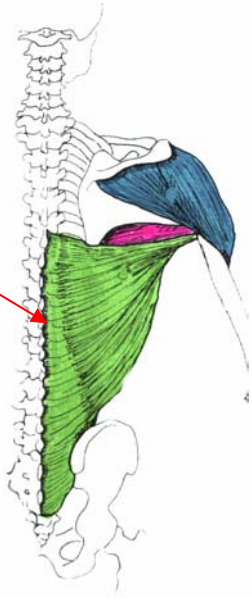
MUSCLES OF THE SPINAL COLUMN

The muscles around the spinal column are referred to as paraspinal muscles. More than 30 muscles and tendons help to provide balance, stability, and mobility to the spinal column.

There are many minor muscles surrounding the spinal column connecting anywhere from 2 to 9 vertebrae (with each assisting in some movement between all the vertebrae and the rest of the skeleton). The two main muscles that extend up and down the spinal column are the **trapezius** and the **lattisumis dorsi**.



Trapezius



Lattisumis Dorsi

ETIOLOGY OF SPINAL CORD INJURY

INTRODUCTION

Trauma to the head, neck, shoulders, torso and / or pelvis as a result of motor vehicle crashes, falls, sporting injuries and other traumatic events may lead to damage of the spinal vertebrae, the protective supports of the spinal column (muscles, ligaments or discs) or to the spinal cord itself. **Primary** and **secondary** SCI can develop either through vertebrae lacerating, pinching or compressing the spinal cord, overstretching of the spinal cord, or cessation of the blood supply to the spinal cord. A progressive tissue destruction process of the spinal cord can also develop. Primary and secondary SCI or progressive tissue destruction appear to be caused by both mechanical factors such as blood vessel compression or laceration, and the chemical factors such as vasodilating endorphins, which precipitate an ischaemic or hypoxic state following a high impact injury.

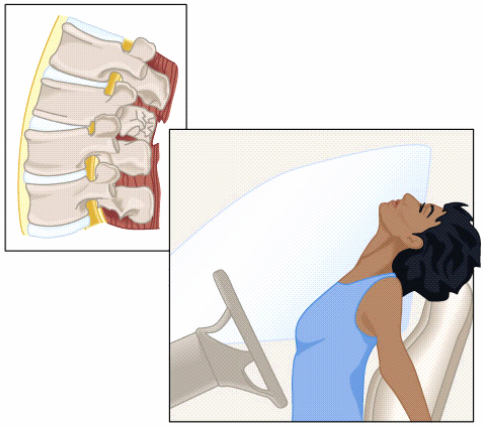
PRIMARY SPINAL CORD INJURY

A primary SCI is the mechanical disruption of axons by the initial mechanical injury. This can be caused by the following types of forces:

Hyperextension

Hyperextension injuries appear in 19% to 38% of SCI and occur when the spine is arched backwards beyond normal limits.

This type of injury is seen most commonly in the upper cervical section of the spinal cord as there is nothing to restrain the head until the occiput hits the lower cervical section. Thoracic and lumbar hyperextension injuries are less common, but often result in fractures to the lamina or vertebral body, or prolapse of a disc.



Hyperextension

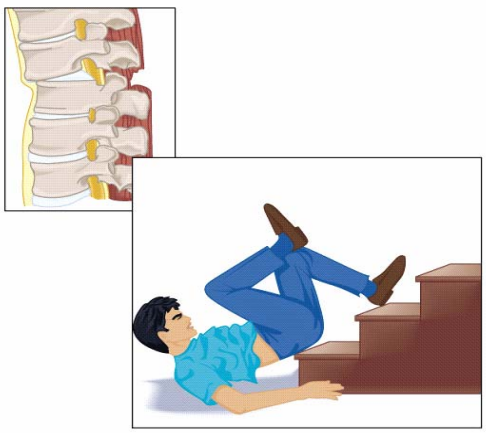
Hyperextension injuries are often caused by:

- Collisions in motor vehicles without head rests.
- Rear end collisions in motor vehicles.

Hyperflexion

Hyperflexion injuries appear when the spine is arched forwards beyond normal limits.

Injuries to the cervical segment occur when the head is pushed forward until the chin makes contact with the chest, fracturing the vertebrae at the front of the cervical spine and tearing the supporting ligaments at the back.



Hyperflexion

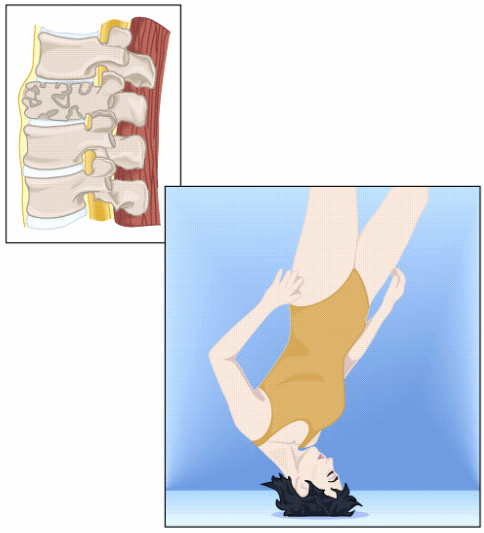
Hyperflexion injuries are often caused by:

- Motor vehicle collisions with lap or lap/sash seatbelts but no SRS airbags.

Compression

Compression injuries occur when the spinal cord is compressed following impact, often resulting in injuries at C_{5-6} and T_{12}-L_1. This type of injury often causes a burst vertebral body.

Compression injuries are often caused by:
- Diving injuries.
- Impacting windscreens in motor vehicle collisions.

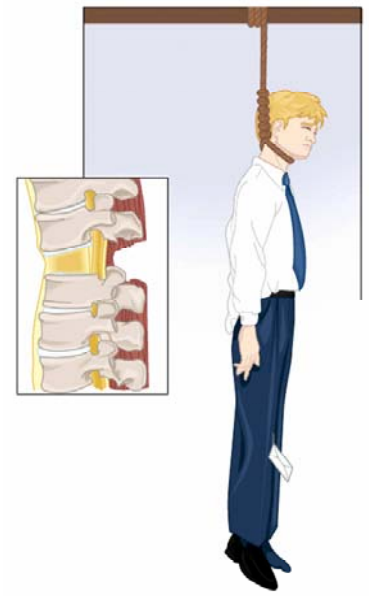


Compression

Distraction

Distraction injuries are an overstretching of the spinal cord.

Distraction injuries are often caused by:
- Hanging injuries.
- Playground injuries to children.

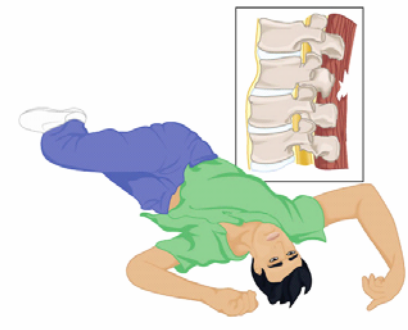


Distraction

Rotation

Rotational injuries occur when head and body rotate in opposite directions resulting in twisting of the muscle, ligaments, vertebrae and / or spinal cord.

Rotational injuries are often caused by:
- Motor vehicle rollovers.
- Ejections from a motor vehicle.



Rotational

SECONDARY SPINAL CORD INJURY

Secondary SCI is a cascade of ongoing events caused by the initial primary cord injury, which damages axons secondarily to the initial primary injury, that otherwise should have survived. If the cause of secondary SCI can be predicted and controlled, further neurological dysfunction may be limited, reversed or prevented.

Causes of secondary SCI are thought to include but are not limited to:

Pathological changes following injury

Following the initial injury to the spinal cord, petechial bleeding (caused by the leaking of blood cells from capillaries) occurs in the grey matter of the spinal cord, as well as in the surrounding white matter.

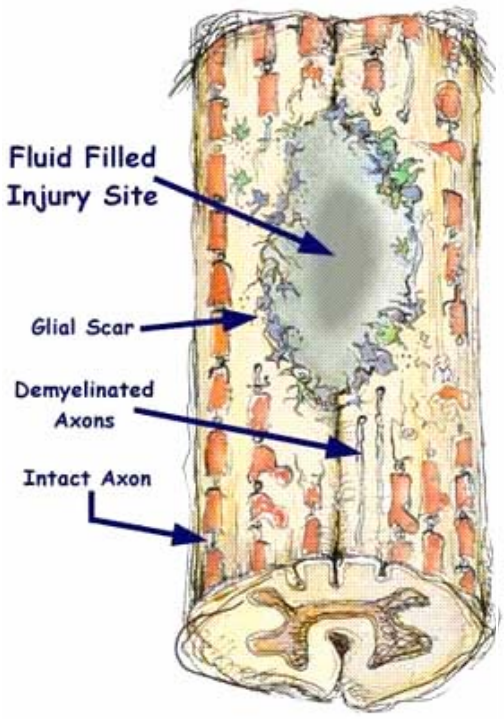
Between 12-24 hours after the initial injury, the grey and white matter in the central region of the spinal cord looses it's structure and becomes a region of dead tissue. The spinal cord's unique blood supply is the probable cause of these changes, and is thought to assist in further structural damage to the spinal cord, and ongoing neurological dysfunction.

Microscopically, there is a breakdown of the capillary structure and disruption of the blood / spinal cord barrier. Significant swelling develops in the surrounding white matter as the bleeding to the central region of the spinal cord continues.

Swelling also interferes with the transmission of impulses at the synaptic cleft.

Changes begin to appear to the axon of the spinal nerve including rupture of the outer membrane covering of the axon, breakdown of the axon's cytoplasm, disruption of the axon's myelin sheath and separation of the myelin sheath from the axon itself. Damage to the myelin severely compromises transmission of nerve impulses throughout the spinal cord.

Macrophages (white blood cells that engulf and digest debris) move in to remove any destroyed spinal cord tissue.



Pathological changes to the spinal cord

Eventually, a fluid filled cavity (syrinx) surrounded by non conducting glial scar tissue is left behind within the spinal cord. The syrinx has now formed a barrier that inhibits the reconnection of axons.

Neurogenic shock

Neurogenic shock, also known as **vasogenic shock**, usually occurs within 30 - 60 minutes following suppression of the autonomic nervous system's ability to maintain vasoconstriction below the level of SCI.

The autonomic nervous system, through the sympathetic nervous system, maintains the muscles of the veins and arteries in a partially contracted state. However, with the loss of sympathetic stimulus, the vascular muscles cannot maintain this contraction and the arteries and veins dilate, drastically expanding the size of the circulatory system, with a corresponding reduction of blood pressure.

These cardiovascular effects may worsen ischemic lesions in the injured spinal cord.

Post traumatic ischemia

Following a severe injury, blood flow to the spinal cord, especially in the veins and in the capillaries supplying the grey matter, is reduced. Causes of reduced blood flow is unclear, but may include one or more of the following:

- Direct mechanical irritation producing vasospasm.
- Release of biochemical agents such as norepinepherine or cAMP.
- Products of lipid peroxidation and arachidonic acid metabolism which are vasoactive causing vasoconstriction and tissue infarction.

Calcium entry into the cells

A dramatic fall in extracellular calcium is seen after an acute injury as the calcium moves into the cells. Calcium moving into the cells causes activation of phopholipases and phosphatases. Phospholipases results in breakdown of membrane phospholipids and the release of free fatty acids. Free fatty acids are converted to eicosanoids such as prostaglandins, which are potent vasoconstrictors, restricting blood flow to the spinal cord.

Excitatory amino acids are also released after injury (primarily glutamate) which also increases intracellualar calcium by activating NMDA receptors, and further compounds the problem.

Increased calcium levels also disrupt a range of cellular processes including transport, secretion, metabolism and ion permeability.

Increased Extracellular Potassium

The transmission of nerve impulses in neurons requires the appropriate levels of sodium and potassium inside and outside the cells.

An increase in extracellular potassium (produced by damage to a relatively small percentage of cells in a particular region) depolarizes intact cells and prevents action potential conduction, which directly affects spinal cord function.

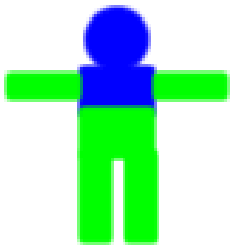
Failure to immobilise unstable fractures

Failure to stabilise and immobilise an unstable fracture has the potential to allow the movement of fragments of bone towards the spinal cord causing either pressure on the spinal cord or actually cutting of the spinal cord.[2-3]

FUNCTIONAL CLASSIFICATIONS

Tetraplegia: Also known as quadriplegia refers to a loss of motor and sensory function in the cervical section of the spinal cord. Arms and legs are affected.

Tetraparesis: Also known as quadraparesis is a condition where the arms and legs are not paralysed, but are weakened or have reduced motor or sensory function.



Tetraplegia

In Australia 54% of SCI are at the tetraplegic level.[1]

Paraplegia: Refers to a loss of motor and sensory function in the thoracic, lumbar or sacral sections of the spinal cord. The SCI patient with still have arm function.

Paraparesis: Is where the legs are not paralysed, but are weakened or have reduced motor or sensory function.

Paraplegia

The remaining 46% of SCI are at the paraplegic level.[1]

INCOMPLETE - COMPLETE CLASSIFICATIONS

SCI is classified as either **complete** or **incomplete** injuries:

Complete Injuries:

Complete SCI are a total loss of motor function (paralysis) and sensory perception as a result of complete interruption of the ascending and descending nerve tracts in the spinal cord.

In Australia, approximately 43% of SCI are complete. Due to the small diameter of the spinal canal, 60% of thoracic SCI are often complete, while only 40% of cervical SCI and 14 % of lumbar & sacral SCI are complete.[1]

Incomplete Injuries:

The majority of SCI in Australia (67%) are incomplete injuries,[1] i.e. there is some function of either motor and / or sensory function below the level of the SCI.

Poor management of the patient with incomplete SCI can cause progressive worsening of spinal cord function.[2-3]

Incomplete SCI are further divided according to the area of SCI and include:

Central Cord Syndrome - is most often seen in hyperextension injuries, with most damage to the spinal cord being in the centre of the cord itself. In this syndrome, there is greater loss of function in the upper extremities, as the nerves to these areas are concentrated more towards the centre of the spinal cord, whilst lower extremity nerves are found towards the outside of the spinal cord.

The majority of patients will walk again and have a return of motor and sensory function to the lower extremities and trunk, but tend to have poor recovery of hand function owing to irreversible central gray matter destruction.

Brown-Sequard Syndrome - occurs when only one side of the spinal cord is damaged. Motor function and positional awareness is lost on the body side with the injury, but loss of touch, pain and temperature perception occurs on the opposite side of the body.

This syndrome has a good prognosis for recovery with more than 90% of patients regaining bladder & bowel control. Most patients will also regain some strength in their lower extremities and be able to walk again.

Anterior Cord Syndrome - occurs most often in flexion injuries which primarily damages the anterior spinal artery and also the anterior 2/3 of the spinal cord. There is paralysis of motor function, as well as loss of touch, temperature and pain perception. The ability to sense the position, location, orientation and movement of the body and its parts remain.

Anterior cord syndrome has the worst prognosis of all spinal cord syndromes with only 10% to 15% of patients showing functional recovery. Prognosis is however good if recovery is seen to progress during the first 24 hours.

Caudina Equina Syndrome - involves injury to the peripheral nerves rather than the spinal cord itself (as the cord ends at L_2). While initial injury may result in anything from partial to complete cessation of motor & sensory function, as the peripheral nerves have the ability to repair themselves, this injury can often repair itself to some degree.

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Towards the prevention of Spinal Cord Injury

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Paraplegia 1988: 143-150
Prevention of Neurological deterioration before admission to hospital

PATIENT ASSESSMENT

INTRODUCTION

When assessing the trauma patient, a standardised and complete process of examination needs to be developed that will indicate to the examining Officer a potential or actual SCI. Information gained from a thorough examination, signs & symptoms found and mechanism of injury are all essential for determining the patient management requirements.

PATIENT APPROACH

When assessing the potential SCI patient, the Officers follows the current basic approach to trauma assessment.

1. **First Officer** undertakes a full assessment of the patient before application of spinal equipment. This includes:

- Check safety, scene, and situation.
- A **Second Officer** brings the cervical spine into the neutral in-line position (unless contra-indicated - pg 51) and performs manual in-line stabilisation of the patient's head (pg 55 - 60), whilst the **First Officer** continues the assessment.
- Perform Primary Survey:
    i. **R**esponse
    ii. **A**irway
    iii. **B**reathing
    iv. **C**irculation (Pulse & Major Bleeds)
- Perform Basic Care:
    i. **R**est,
    ii **R**eassure
    iii. **O**xygen
    iv. **P**osition
    v. **P**ulse Oximeter
    vi. **E**GC Monitor
- Perform A Vital Signs Survey:
    i. **C**onscious Status Assessment - **E**ye Opening
    - **V**erbal Response
    - **M**otor Response

    ii. **P**erfusion Status Assessment - **P**ulse
    - **B**lood Pressure
    - **S**kin

    iii. **R**espiratory Status Assessment - **R**ate
    - **R**hythm
    - **E**ffort
    - **S**ounds
    - **S**peech

- Perform A Secondary Survey:
    i. Motor / Sensory x 4
    ii. Head
    iii. Spine
    iv. Chest
    v. Abdomen
    vi. Pelvis
    vii. Legs
    viii. Arms

- Check AMPLE:
    i. **A**llergies
    ii **M**edications
    iii. **P**ast medical history
    iv. **L**ast oral intake
    v. **E**vents leading up to injury

- Apply Spinal Equipment as required:
    i. Cervical Collar (pg 73 - 80)
    ii Cervical Extrication Device (pg 81 - 95)
    iii. Long Spine Board (pg 96 - 136) or
    Scoop Stretcher (pg 194 - 207) or
    Vacuum Mattress (pg 218 - 230)
    Iv. Full Spine Immobilisation[39-40] (pg 208 - 217)

SIGNS & SYMPTOMS OF SCI

The use of signs & symptoms alone to determine the presence of SCI has been found in multiple studies to be ineffective and will miss 40% - 60% of patients with SCI.[1-10] A multitude of reasons exist for the these missed injuries including distracting injuries or events, alcohol consumption, drug usage, unconsciousness or an altered conscious state, and communication difficulties due to extremes of age, language barriers or intellectual disabilities.[3-11]

Attempts to diagnose the actual level of injury should also be discouraged. Reasons for this include 40% - 60% of patients will have no pain over the damaged area due to a range of issues as listed above.[3-11] Various studies show persons suffering traumatic fractures to the spinal column will have a 20% - 66% occurrence of a secondary fracture elsewhere in the spinal column.[14-15]

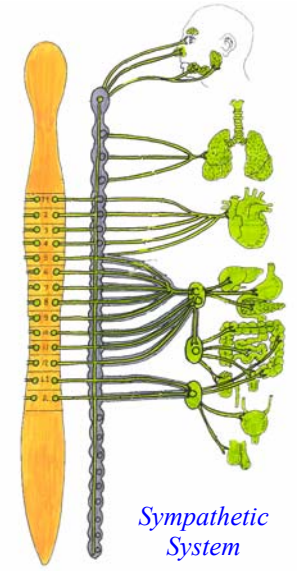
A range of signs & symptoms may be seen in the potential or actual SCI patient and include:

Bradycardia

The control centre for the heart rate is found in the medulla's vasomotor centre of the brainstem and is under control of the Autonomic Nervous System. The Autonomic Nervous System's sympathetic nerves (which come from the spinal cord T_1 to L_2) speed up the heart rate, whilst the parasympathetic nerves (which are mainly cranial nerves) slow the heart down.

A bradycardia in SCI occurs due to interruption of the brainstem's communication to the spinal cord resulting in the loss of the sympathetic control.

The parasympathetic system can now act unopposed, without the sympathetic influence, leading to a slowing of the heart rate.



Sympathetic System

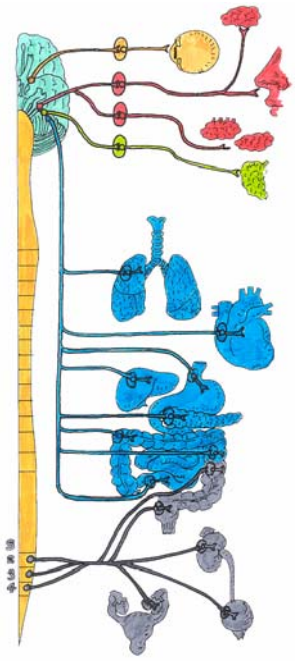
The bradycardia can be effectively treated in the acute prehospital stage with Atropine.[36]

Hypotension

The control centre for vasoconstriction and vasodilation of the blood vessels is found in the medulla's vasomotor centre of the brainstem and is under control of the Autonomic Nervous System. The Autonomic Nervous System's sympathetic nerves (which come from the spinal cord T_1 to $L_{2)}$ constrict the blood vessels, with the parasympathetic nerves having only a minor effect on dilation of the blood vessels.

Hypotension in SCI occurs due to interruption of the brainstem communication to the spinal cord resulting in the loss of the sympathetic control thus resulting in dilation of the peripheral blood vessels and therefore hypotension. Hypotension leads to ischemic SCI.[36]

SCI induced hypotension (also called neurogenic shock) can be treated in the acute prehospital stage with carefully controlled fluid replacement to avoid pulmonary edema, or by vasoconstricting drugs such a Aramine or Adrenaline. Due to these drugs short half life, repeated doses or infusions are often required.[36]



Parasympathetic System

Hyperthermia / Hypothermia

The loss of the sympathetic control results in dilation of the peripheral blood vessels causing peripheral vasodilation below the level of injury. This dilation causes skin to initially feel warm. As time progresses, hypothermia develops as the loss of muscle contraction due to paralysis causes a significant reduction in body heat production. Dilation of the blood vessels close to the skin also results in heat loss by convection.

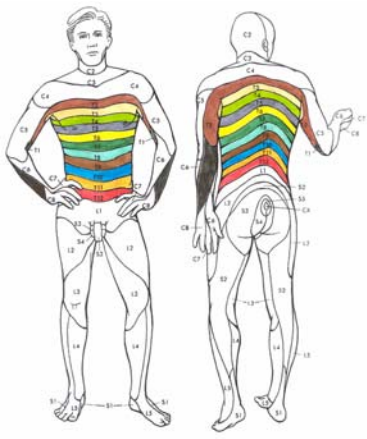
Acute prehospital treatment of SCI induced hypothermia is aimed at maintaining normal body temperature by the use of blankets.[36]

Breathing Difficulty

The diaphragm provides 70% of normal inspiration / expiration effort, with the intercostal muscles accounting for only 30% of respiratory effort.

A sensation of shortness of breath will occur if the SCI is in the thoracic region of the spinal cord (T_{1-12}) as the intercostal muscles, which allow chest expansion for respiration, are now paralysed. The higher the level of injury, the greater the sensation of breathlessness.

Prehospital care of a SCI patient with breathing difficulties should include supplemental oxygen to cater for up to 30% reduction in respiration ability, and the removing of any restrictions placed on the diaphragm to contract.

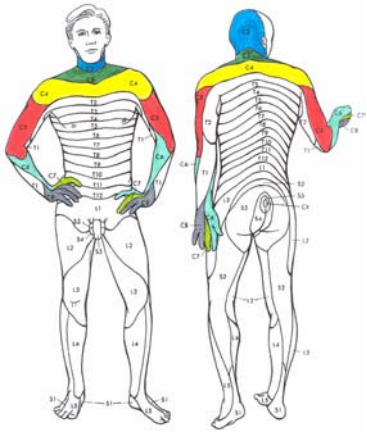


Nerve supply to Intercostal Muscles

Diaphragmatic Breathing

SCI injuries above T_1 results in a total loss of the intercostal muscles that assist with respiration, placing total reliance on the diaphragm for breathing.

To assist the patient's diaphragmatic respiration, prehospital care should include supplemental oxygen to cater for the 30% reduction in respiration, and the removing of any restrictions placed on the diaphragm to contract.



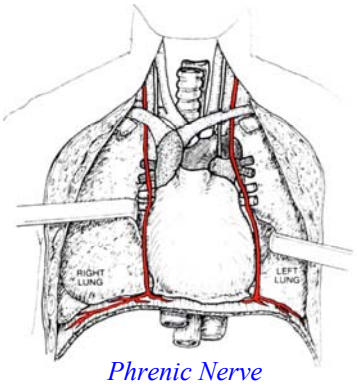
Nerve supply to Diaphragm

Respiratory Arrest

Nerve supply for the diaphragm comes from the phrenic nerve which exits the spinal cord at C_4, with some innervation also from C_3 and C_5 as well.

SCI injuries at C_{1-3} will cause a loss of all muscles for respiration, resulting in the inability of the patient to breath.

Prehospital care of the non-breathing SCI patient should include artificial ventilation of the patient using a Bag-Valve-Mask, and depending on level of skill, insertion of an oropharyngeal airway, LMA or endotracheal tube.



Phrenic Nerve

Paralysis And Numbness

Paralysis and / or numbness in the trauma patient may be indicators of significant damage to the spinal cord itself. Such symptoms may occur in one or more limbs. In a small number of cases, it may also be a temporary effect caused by a sudden temporary cessation of the autonomic nervous system that occurs following trauma (spinal shock) which may last hours to weeks.

Acute prehospital care, when paralysis or numbness is present, is to reduce any ongoing ischemia or swelling that may be causing the loss of motor or sensory function. This can include supplemental oxygen therapy, the use of methylprednisolone to help reduce inflammation,[36] and maintaining adequate blood flow to the spinal cord by ensuring adequate perfusion (both pulse and blood pressure).[36] Immobilisation of the spinal column to prevent further bone movement damaging the spinal cord is also beneficial.[8, 10-

Heaviness And Tingling

Heaviness and / or tingling sensations in one or more limbs are indicators of possible pressure being exerted on the spinal cord by either a bone or through swelling, but suggests that the cord is still intact.

Acute prehospital care when heaviness and / or tingling sensations are present is to prevent further bone movement that may be pressing on the spinal cord by immobilisation of the spinal column,[8, 10-17, 18-31, 39] and to reduce any ongoing ischemia or swelling that may be causing the sensory changes by giving supplemental oxygen therapy, and maintaining adequate blood flow to the cord by ensuing adequate perfusion (both pulse and blood pressure) to reduce ischemic injury.[36] The use of methylprednisolone to help reduce inflammation is also an option.[36]

Pain Or Tenderness

Pain or tenderness over any portion of the spinal column is a sufficient indicator to suspect potential SCI damage. It is however only stated as being present in 40% - 60% of SCI patients due to a range of reasons including natural release of endorphins, distracting injuries, unconscious patient , drug usage, alcohol consumption, neuropathy in the eldery, communication difficulties due to extremes of age, etc.[3-11]

Pain management in the prehospital setting for SCI should include the use of drugs such as Penthrane™ or Morphine™ to reduce pain to a comfortable and tolerable level.

Deformity

Deformity is a definite indication that significant damage has occurred to the spinal vertebrae, but it is only seen in 3% of SCI. This is in part due to the anatomy of the spinal column. At C_1 to C_5 no vertebra bone can be felt on examination. From C_6 to L_5 only the posterior aspect of the spinous process is palpable. As a result, there exists controversy as to whether the patient assessment should include palpation of the spinal column to determine if such deformity exists, especially if the patient needs to be moved to examine this area.

Priapism

Priaprism is a sustained erection of the penis in a male that occurs following the loss of sympathetic nerve control resulting in dilation of blood vessels in the lower body including the deep and dorsal arteries of the penis.

LIMITATIONS OF SIGNS & SYMPTOMS OF SCI

By charting the more common SCI signs & symptoms seen prehospital, actual SCI can be effectively diagnosed in the conscious patient in the field. However, if swelling within the spinal canal is not yet placing pressure on the spinal cord, or an unstable vertebral fracture has not yet damaged the spinal cord, then it can be demonstrated that many patients would not exhibit any signs & symptoms indicating their injury and SCI would be missed.[8, 10-16]

Sign & Symptoms	Cord Damaged	Cord Not Yet Damaged
Bradycardia	Yes	No
Hypotension	Yes	No
Hypothermia	Yes	No
Respiratory Difficulty	Above T_{12}	No
Diaphragmatic Breathing	Above T_1	No
Respiratory Arrest	Above C_4	No
Paralysis	Yes	No
Numbness	Yes	No
Heaviness	Yes	No
Tingling	Yes	No
Pain	40% - 60%[3-11]	40% - 60%[3-11]
Deformity	3%	3%
Priapism	Yes	No

Signs & symptoms can be ineffective when used in isolation to determine a potential or actual SCI.[8, 10-16]

MECHANISMS OF SCI

As stated earlier, only 40% - 60% of spine-injured patients exhibit signs & symptoms of their injury.[8, 10-16] Using this as the only criteria for recognition would exclude a large percentage of patients with potential or actual SCI .

It has been well established that if 'Mechanisms' and 'Pattern' of injury are also included in the assessment for a potential SCI, then very few patents will be missed. Some standards used include but should not be limited to:

Mechanisms Of Injury:
Occupants of high-speed MVC's.
Pedestrians hit by vehicles traveling > 30 kph.
Patients ejected from motor vehicles.
Patients in a motor vehicle which has rolled over following an MVC.
Patients in a motor vehicle where there is a death of another occupant.
Patients falling greater than 2 ½ times their height.
Patients hit by falling object, falling greater that 2 ½ times their height.
Motorcyclists, cyclists > 30 kph.
Explosions.
Entrapments > 30 mins.

Patterns Of Injury:
Penetrating injury to the head, chest, abdomen, or pelvis.
Significant blunt trauma to the head, chest, abdomen, or pelvis.

This should not be considered a definitive list, but should be used as a guide to the more common injuries leading to potential SCI. Patients with lesser mechanisms of injury can also suffer SCI, as seen in falls in which >40% of falls in Australia that resulted in SCI occurred from a height of below 1 m.[40]

SPINAL CLEARANCE IN THE FIELD

The use of signs & symptoms of SCI in conjunction with mechanisms and patterns of injury provide an excellent level of diagnosis of potential or actual SCI. But it also leads to many patients being unnecessarily immobilised.[3-5]

Recent studies reviewing SCI clearance in the prehospital setting have established a criteria allowing effective clearance in the field.[3-5] These studies have determined why pain does not appear in 40-60% of patients. The reasons include:

Altered Conscious State

Any patient with an altered conscious state or a period of unconsciousness may be confused and not able to answer questions regarding pain or injuries correctly.

Alcohol or Drug Use

Any patient who has ingested alcohol or consumed elicit drugs again may be confused and not able to answer questions regarding pain or injuries correctly.

Distracting Injuries

Distracting injuries are those injuries which cause sufficient pain to distract the patient from spinal pain that may be present. Such injuries are long bone fractures,[3-5] but may also include amputations, dislocations and other injuries causing significant distracting pain to the patient.

Distracting Event

Distracting events are situations that cause the patient to be sufficiently distracted from spinal pain that may be present. Such events include a parent who's child has been critically injured, and as such is unaware or unwilling to admit to their own pain until the child is adequately cared for.

Modifying Factors

Modifying factors refer to problems of communication with the patient. Such situations include:

- In young children where communication is limited.
- Patients where a language barrier exists.
- Patients with intellectual disabilities which makes communication difficult.
- The elderly (>65 yrs of age) due to neuropathy and / or other diseases that affect pain perception.

CRITERIA FOR (SELECTIVE) PREHOSPITAL SPINE IMMOBILISATION

In determining who to spinal immobilise, the following criteria can be effectively used on the adult patient:[3-5, 41-42]

1. **Signs & Symptoms of SCI exist**

   OR

2. **A Mechanism Of Injury exists that has the potential to cause SCI AND there exists one or more of the following:**
   - Pain or other signs & symptoms of SCI.
   - Altered Conscious State.
   - Alcohol or drug intake.
   - Trauma above the clavicles
   - Distracting injury or events.
   - Modifying factors (extremes of age, communication difficulties).

IMMOBILISING THE SCI PATIENT

Once the patient has been assessed and it is determined that the patient has potential or actual SCI, the patient requires immobilisation.[8, 10-17, 18-31, 39-40]

Spinal care management is the same as the treatment of any other fracture, that is, splint the joint above and below the fracture sight. To achieve this, treatment should be thought of as a 4 step process:

Step 1 The head is re-aligned into the "eyes front" position & the cervical spine is initially stabilised with **Manual In-Line Stabilisation** (pg 55 - 61) and a rigid **Cervical Collar** is applied (pg 73 - 80).[12, 29-33]

Step 2 - If the patient is sitting in a vehicle or confined space and is non-time critical or the patient is trapped, a **Cervical Extrication Device** (pg 81 - 95) can be applied.[34-35]

Step 3 - The torso, pelvis and limbs should be re-aligned and securely splinted to a solid, but portable platform (pg 208 - 217) known as a **Full Spine / Body Immobiliser** (such as a **Long Spine Board** (pg 96 - 136), **Scoop Stretcher** (pg 194 - 207) or **Vacuum Mattress** (pg 218 - 230)).[10-11, 15-17, 20-25, 39]

Step 4 - The head is securely splinted to the **Full Spine / Body Immobiliser** by use of a **Head Immobiliser**.[10, 29-33]

CONTRA-INDICATIONS TO RE-ALIGNING THE SPINE

While Full Spine / Body Immobilisation in the anatomical position is the aim of spinal care,[8, 12, 15-17, 18-23] there are times when realigning the spinal column is contra-indicated. These include:

If the patient is conscious and:

- There is pain upon starting the movement.
- There is muscle spasm or back pressure upon attempting the manoeuvre.
- The patient holds their head or part of their torso in an angulated (tilted) position and states that they are unable to move it.
- The manoeuvre cannot safely be achieved due to space limitations or other conditions.

If the patient is unconscious, and:

- There is muscle spasm or back pressure upon attempting the manoeuvre.
- The manoeuvre cannot safely be achieved due to space limitations or other conditions.

If any of the above conditions exist, the spine must be splinted as found using towels, blanket rolls or straps as required.

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MANUAL IN-LINE STABILISATION

MANUAL IN-LINE STABILISATION

INTRODUCTION

On arriving at the scene of a potential or actual SCI patient, one of the first procedures in spinal management is to stabilise the cervical section of the spinal column. This can rapidly be achieved by the use of **Manual In-Line Stabilisation** of the head.[1-2]

The aim of Manual In-Line stabilisation is twofold:

- To provide immediate temporary stabilisation of the cervical spine.
- To join the head to the chest to stabilise the neck.

LIMITATIONS OF MANUAL IN-LINE STABILISATION

There are a number of limitations to Manual In-Line Stabilisation alone:

- Manual In-Line Stabilisation alone, without the support of other immobilisation devices, has never been proven in any studies to be safe.[3] Further splinting will be required before transport. A rigid Cervical Collar will at best provide only 50% immobilisation.[4-10] Therefore, Manual In-Line Stabilisation should be maintained even after a Cervical Collar has been applied (pg 73 - 80) , and until either a Cervical Extrication Device (pg 81 - 95) or a Full Spine Immobiliser has been applied (pg 208 - 217) to adequately stabilise the cervical spine.[4-11]
- It provides no thoracic / lumbar spinal support to the patient.
- It does not take the weight of the patient's head off the cervical spine.
- It should only be used whilst the patient is not being moved.

DANGERS OF MANUAL IN-LINE STABILISATION

A number of dangers may be associated with Manual In-Line stabilisation:

- If the patient's teeth are clamped closed when performing Manual In-Line Stabilisation, the airway may be compromised if the patient vomits.
- Neck pressure increases intracranial pressure, therefore do not place hands on the patient's neck.
- Do not place traction to the patient's head, as traction is dangerous in the prehospital setting.[20-22]
- The patient's head must be immobilises to their chest to prevent neck movement. Failure to achieve this means the neck becomes the pivoting point.

STABILITY DURING MANUAL IN-LINE STABILISATION

To gain the greatest amount of stability:

- The Officer fans their fingers to obtain the greatest amount of contact as possible with the patient's head .
- The Officer should rest their elbows on a stable object such as the ground, seat or their own torso, as this will prevent swaying of the Officers arms as they become tired.

MANUAL IN-LINE STABILISATION: BEHIND

- From behind the patient, the Officer places their hands over the patient's ears.
- The Officer then places thumbs of each hand against the posterior aspect of the patient's skull and at the same time the Officer places both of their little fingers just above the patient's angle of the mandible.
- The Officer now places their index and ring fingers of each hand on either side of the appropriate cheek bone of the patient.
- If the patient's head is not in the neutral in-line position, slowly realign it, unless contra-indicated (pg 51).
- The Officer bring their arms in at the elbows and rests their arms against the seat, headrest or the Officer's own torso.

MANUAL IN-LINE STABILISATION: SIDE

- The Officer stands at the side of the patient, then passes one arm (the arm closest to the patient's back) over the patients shoulder, and cups the back of the patient's head with the hand belonging to this arm.
- Between where the upper molars insert in the maxilla and the inferior margin of the zygomatic arch, there is an indentation ideal for grasping. The Officer places the thumb and first finger of their other hand on the patient's cheeks so that it grasps the patient, in the above indentation.
- If the patient's head is not in the neutral in-line position, slowly realign it, unless contra-indicated (pg 51).
- The Officer brings their arms in at the elbows and rests their arms against the seat, headrest or the Officer's own torso.

MANUAL IN-LINE STABILISATION: CAUDAL SUPINE

- The Officer kneels or lies down behind the patient's head and places their elbows on the ground for stability. If kneeling, the Officer moves their knees back at least 60 cm from their elbows.
- The Officer slides the webbing between the ring finger and middle finger of both hands to cup the patient's ears.
- The Officer then place the thumbs of both hands against the patient's forehead.
- The Officer then place the little fingers of both hands at the patient's angle of the mandible.
- The Officer then place the index finger and ring fingers of both hands above and below each of the patient's zygoma.
- If the patient's head is not in the neutral in-line position, slowly realign it, unless contra-indicated (page 51).

MANUAL IN-LINE STABILISATION: SIDE SUPINE

This technique is not as easy or as stable as the Manual In-Line Stabilisation: Caudal Supine, but is a common precursor to the knee-clamp, when the Officer is unable to get behind the patient's head, or when preparing for the Intubation Straddle.

- The Officer kneels beside the patient's mid-torso, facing the patient's head.
- The Officer places his palms on each side of the patient's head with the palms resting over the zygomas with the fingers pointing at a 45º angle towards the ground.
- The Officer now move their thumbs to the patient's forehead and little fingers behind the patient's occiput. The Officer's other fingers should now spread out across the posterior aspect of the patient's skull.
- If the patient's head is not in the neutral in-line position, slowly realign it, unless contra-indicated (page 51).

MANUAL IN-LINE STABILISATION: KNEE CLAMP

This technique can be used for effectively maintaining cervical spine stabilisation for single person application of a Cervical Collar 9pg 73 - 80), or when IPPV is required in the potential or actual SCI.

- The Officer kneels down behind the patient's head. The Officer then places their hands flat on the ground on either side of the patient's shoulders.
- The Officer then lifts their knees off the ground and moves them forward towards either side of the patient's head.
- The Officer bring their knees in gently against the patient's head, clamping the head. The Officer lower their knees to the ground at the same time.

MANUAL IN-LINE STABILISATION: FOR INTUBATION

While there remains controversy about intubating patients due to the amount of spinal movement that may occur during the procedure,[16-17] and whether nasal is preferred over oral intubation, it has been shown that the amount of cervical spine movement involved in ventilating with a BVM in an unintubated patient is greater than the amount of cervical spine movement involved in intubating a patient.[18] Although there are a number of positions that can be adopted to intubate, the following has been found to be the most effective in the supine patient.[19]

- Officer 1 adopts the Knee Clamp position (refer Manual In-Line Stabilisation: Knee Clamp (pg 59)) and begins IPPV until ready to intubate.
- When Officer 1 is ready to intubate, Officer 2 kneels besides the patient's torso and grasps the head, taking over Manual In-Line Stabilisation: Side Supine (pg 58). Officer 1 now unclamps their knees.
- Officer 1, who is to perform the intubation, sits on the ground above the patient's head, with one leg over each of the patient's arms and gently moves forward until the patient's head can be secured between Officer 1's thighs. Officer 1 can now lean back until the cords are visualized and then performs the intubation.

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JAW THRUST

INTRODUCTION

The jaw thrust is a manoeuvre to open the airway of an unconscious patient. The triple airway manoeuvre as used on the unconscious medical patient will place the cervical spine into a hyper extended position and is therefore contra-indicated for the potential or actual SCI patient.

SUPINE PATIENT

Procedure:

1. The Officer kneels behind patient's head.
2. The Officer's thumbs are placed on either side of the patient's cheek bones.
3. The Officer's index fingers is placed on either side of the patient's angle of the mandible .
4. The Officer applies pressure downwards with both thumbs, whilst simultaneously applying upward pressure on the angle of the mandible, sufficient enough to push the jaw forward and open the airway.

Jaw Thrust - Supine

PATIENT ON SIDE

Procedure:

1. The Officer kneels behind patient's head.
2. The Officer's index finger of one hand is placed on the patient's upper cheek bone.
3. The Officer's thumb of the same hand is placed on the patient's angle of the mandible.
4. The Officer applies backward pressure on the patient's upper cheek bone using the index finger. The Officer simultaneously applies forward pressure on the angle of the mandible with the thumb of the same hand sufficient enough to push the patient's jaw forward and open their airway.

Jaw Thrust - Side

MOTORCYCLE HELMET REMOVAL

MOTORCYCLE HELMET REMOVAL

INTRODUCTION

Treatment of the motorcycle trauma patient generally requires removal of the patient's helmet to allow easy access to the patient's airway and to allow proper examination of their face, ears and skull. Despite the need to remove the helmet, prehospital personal are in general, poor at performing the **Helmet Removal Technique** safely and correctly.[1]

TYPES OF HELMETS

Four basic motorcycle helmets are currently in use:

Full Face

Modular Flip-Up

Off-Road

Open Face

For the helmet to fit correctly on the motorcycle rider and not fall of in an crash, it must be a firm fit with the rider's skin moving with the helmet. The rider's sides & top of head, as well as their cheeks, should move with the helmet when the rider shakes their head. This required firm fit will potentially result in movement of the cervical spine during the helmets removal.[1-2]

REASONS FOR HELMET REMOVAL

Controversy appears to exist in regards to leaving the rider's helmet in-situ for transport to hospital or removing it at the crash scene. In general, leaving a helmet on the rider will:

- Interfere with administration of oxygen therapy.
- Prevent the application of a Cervical Collar.
- Cause an airway compromise if the patient vomits.
- Place the head into hyperflexion due to the helmets bulk.
- Hyperflexion caused by the helmet may occlude the airway in the unconscious rider.

REASONS FOR NOT REMOVING HELMET

Helmets are generally best left in place when:

- A penetrating injury to the head has possibly occurred.
- Increasing neurological deficit occurs during the removal of the helmet.

HELMET AND SPINE ALIGNMENT

Larger style helmets will often place the rider's cervical spine into the hyperflexed position and prevent correct placement of a Cervical Collar.

Therefore, if there is a need to keep the helmet in situ, padding will need to be placed under the thoracic / lumbar spine.

No padding

Padding under torso with a blanket

HELMET REMOVAL TECHNIQUE

The following technique is the current teachings from the PHTLS course, approved by the American College of Surgeons - Committee On Trauma, and offers the best technique for full face motorcycle helmet removal. Two separate studies undertaken on cadavers using this technique suggests that some spinal manipulation will occur,[2-3] and so the procedure should be carried out with extreme care. If neurological deterioration occurs during the procedure, cease the removal of the helmet and immobilise the patient with the helmet in situ.

Training Requirements:	**2 x Staff** **1 x Patient** **1 x Motorcycle Helmet**

Procedure

Step 1

Officer 1 kneels or lies above the patient's head. Officer 1 places their hands on either side of the helmet, and brings the patient's head into the neutral in-line position unless contra-indicated (pg 51).

Step 2

Officer 2 kneels along side the patient's torso, lifts the face shield, removes the patient's glasses, and undoes the helmet's chin strap.

Step 3

Officer 2 now grasps the patient's mandible with one hand so that the Officer's thumb is at the patient's angle of the mandible on one side and the Officer's first two fingers are at the patient's angle of the mandible on the other side. Officer 2 places their other hand under the patient's neck making contact with the occiput of the skull.

Officer 2 now takes over Manual In-Line Stabilisation of the patient's cervical spine.

Step 4

Officer 1 now releases their hold on the sides of the helmet. Then holding the base of the helmet by it's sides, Officer 1 gently spreads the helmet's sides slightly apart.

Officer 1 now rotates the helmet so that the lower end of the face piece is rotated towards themself, and elevates the helmet - clearing the patient's nose.

Step 5

Officer 1 then pulls the helmet off the patient's head in a straight line until the patient's head begins to push upwards. The back of the helmet is then rotated vertically upwards at about 30º following the curvature of the patient's head and is removed.

Step 6

Officer 1 again takes over Manual In-Line Stabilisation of the cervical spine (pg 55 - 61) until Full Spine Immobilisation is completed (pg 208 - 217).

If the head is not in the neutral in-line position, slowly realign it, unless contra-indicated (page 51).

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MOTOR / SENSORY X 4 NEUROLOGICAL EXAMINATION

iNTRODUCTION

The Motor / Sensory x 4 Neurological Examination, also known as M / S x 4 is a rapid prehospital assessment of the patient's neurological functions taking between 20 - 30 seconds to complete. More complicated methods of neurological assessment should be avoided prehospital, due to time required to perform verses actual benefit.

SENSORY FUNCTION EXAMINATION

M / S x 4 begins with a sensory exam of the 4 limbs.

As it is the cranial nerves (and not the spinal cord) that provides sensation to the patient's forehead, the forehead is used as the comparison measurement to measure against sensation in the limbs

Nerve supply to forehead is from the cranial nerves and not the spinal cord

Sensation is initially checked in the patient's upper body by examining sensation across the back of both hands against sensation in the forehead.

This will determine the function of the spinal cord at C_6, C_7 and C_8.

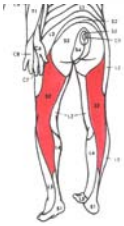
Sensation check of the hands

Nerve supply to the hands

Sensation in the patient's lower body is checked by examining sensation under both knees and comparing sensation against the forehead.

This will determine the function of the patient's spinal cord at S_2. It should be noted that nerve supply to the feet are higher up the spinal cord (L_5 - S_1), therefore checking under the knees is more beneficial and requires less stretching for the examining Officer.

Sensation check under the knees



Nerve supply to the legs

MOTOR FUNCTION EXAMINATION

The Motor function check is of the 4 limbs.

Begin with the patient grasping both of the Officer's hands to confirm motor nerve function is present, and compare the patient's strength in both hands to determine if any reduced motor function has occurred.

Motor function check of the hands

The patient is then asked to push downwards against the Officer's hands with both feet to confirm motor nerve function is present, and compare the patient's strength in both legs to determine if any reduced motor function has occurred.

Motor function check of the legs

CERVICAL COLLARS

CERVICAL COLLARS

INTRODUCTION

The inception of the Cervical Collar dates back to the Vietnam war in the early 1960's. It was considered that the then current treatment of placing patients with potential or actual SCI on a stretcher with only sandbags placed on each side of the head was inadequate, and that the cervical spine required initial stabilisation with a rigid device to protect the spinal cord.

Initially, makeshift collars, using rolled up towels, were implemented. The soft foam collar saw introduction in the late 60's, but although very comfortable, provided little more than 10% immobilisation. In 1974, Glen Hare who later became CEO of Dyna Med, designed the first true extrication collar using a medium density foam, that whist still providing reasonable comfort, gave greater immobilisation to the cervical spine. In the late 1970's, semi rigid collars began to be developed using polyethylene plastic. Being extremely strong and durable, this product still remains the primary material used in collars today.

FUNCTIONS OF THE CERVICAL COLLAR

Since the introduction of the Cervical Collar in the early 1960's, there have been many misconceptions about the role of the device and what it actually does. Although many x-ray studies have been carried out that show the limitations of the collar as a cervical spine splinting device,[1-7] over the years many prehospital care providers have assumed that by applying a collar to the patient, the patient is safe from any further injury to their spinal cord, meaning the whole spinal cord. The results of such misconceptions have led to improper handling of patients.

The Cervical Collar does however have a use in the prehospital setting, with it's main purposes being:

- Temporary support to the head of a sitting or standing patient until the patient can be placed in a supine position.
- To free the hand of Officers whilst the patient is being moved & splinted to a Full Spine Immobiliser.
- To reduce compression of the cervical spine caused by the head (8 to 16 kg)
- Minimising axial loading / unloading of the spine that takes place in an ambulance during transport (i.e. acceleration / deceleration).
- To highlight to other Health Care Providers that the patient is a potential or actual SCI victim.

LIMITATIONS OF THE CERVICAL COLLAR

The Cervical Collar:

- Is **NOT** designed to immobilise the cervical spine, let alone the rest of the spine. Restriction of movement of the head with a rigid collar is at best 50% of normal movement.[1-7]
- Is **NOT** designed to provide any traction to the head, but is only designed to support the weight of the head. Traction, although applied in the hospital setting, is a dangerous procedure in the field.[8-11]
- Only prevents 50% of cervical spine movement.[1-6]
- Provides no thoracic / lumbar spinal support.
- Has not been shown in any study to adequately immobilise the cervical spine.[1-7]

Therefore following application of a Cervical Collar, Manual In-Line Stabilisation of the head (pg 55 - 61) must be maintained until Full Spine Immobilisation (pg 208 - 217) is achieved.[1-7]

DANGERS OF THE CERVICAL COLLAR

A number of dangers may be associated with application of a Cervical Collar:

- If the jaw support of the collar clamps the teeth together, airway compromise may result if the patient vomits.[12]
- Cervical Collars that place pressure on the neck (either via collar design or too small a Cervical Collar being applied), may cause an increase in intracranial pressure.[14-16]

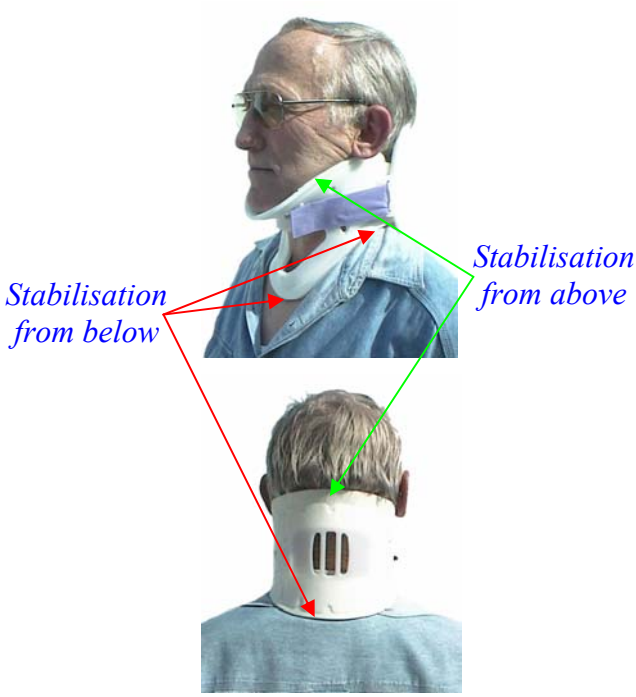
CERVICAL COLLAR STABILITY

The Cervical Collar gains it's stability from below by:

- Lateral contact with both of the clavicles.
- Anterior contact with the sternum.
- Posterior contact with the cervical spine at C_7.

The Cervical Collar gains it's stability from above by:

- Anterior contact of the jaw support with the jaw line, or
- Preferably by anterior contact of the jaw support by the angle of the mandible.
- Posterior contact with the occiput.



CERVICAL COLLAR CLOSURE

The Cervical Collar has been designed for left hand drive vehicles. Therefore application is designed for holding the front of the Cervical Collar in the left hand and securing the Collar's velcro closure with the right hand.

CERVICAL COLLAR SIZES

Cervical Collars are designed for the following range of patients.

- Baby No-Neck ….. 2 – 5 year old
- Paediatric ….. 5 – 8 year old
- No Neck ….. 40% approximately of the population
- Short ….. 35% approximately of the population
- Regular ….. 15% approximately of the population
- Tall ….. 5% approximately of the population

In general only 55% of patients will fit perfectly into one of these sized collars. The majority of patients will have an ill-fitting Collar.

APPLICATION OF A CERVICAL COLLAR

Training Requirements:	**2 x Staff** **1 x Patient** **1 x Cervical Collar**

Procedure

Step 1

- Officer 1 performs Manual In-Line Stabilisation (pg 55 - 61), re-aligning the cervical spine if not contra-indicated (pg 51).
- If the cervical spine cannot be re-aligned, the rigid style Cervical Collar cannot be applied.
- When applying Manual In-Line Stabilisation, just enough traction should be applied to take the weight of the patient's head off the cervical spine only. Further traction is considered extremely dangerous in the prehospital setting.[8-11]

Step 2

- After the patient has been examined (page 43), Officer 2 selects the appropriate size Cervical Collar as per manufacturers guidelines.
- If possible, remove clothing around the patient's neck and ensure the collar is in contact with bare skin for improved stability.
- Slide the Cervical Collar along the patient's chest and into position.
- If using a rigid style Cervical Collar with a jaw support, ensure that the front of the jaw support and patient's anterior aspect of the jaw are level. If the Cervical Collar jaw support protrudes past the patient's jaw, the Cervical Collar is too small. Another Cervical Collar will then need to be selected even if the manufacturer's guidelines for measuring were correctly followed.

Correct Size

Too Small

Too Large

Step 3

- Once the correct size Cervical Collar has been chosen, remove the Cervical Collar away from the patient's sternum.
- Reapply the Cervical Collar by sliding the Cervical Collar in sideways from the right side.

Step 4

- Once the Cervical Collar has been slid in behind the patient, Officer 2 locates & holds the Collar's velcro tab in their right hand.
- Officer 2 now slides the Cervical Collar's right shoulder arch into position on the patient's right shoulder.

Step 5

- Slide the Cervical Collar's jaw support into position and ensure the Cervical Collar is correctly centered anteriorly on the patient's jaw and sternum.
- Officer 2 now secures the velcro closure.
- Officer 1 continues to maintain Manual In-Line Stabilisation until the patient is immobilised into a Cervical Extrication Device (pg 81 - 95) or onto a Full Spine Immobiliser (pg 208 - 217)[17] as a Cervical Collar has been shown to provide inadequate cervical spine immobilisation.[1-6]

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CERVICAL EXTRICATION DEVICE

INTRODUCTION

Cervical Extrication Devices (**CED**) were first developed in the early 1960's by US Airforce's Colonel Kossuth, Commander of the Medical Training School in Alabama as an extrication tool to assist in the removal of a patient from a motor vehicle. This first CED was the wooden Short Spine Board (SSB), which was found not only to be effective as an extrication tool, but studies found it increased cervical spine immobilisation over a Cervical Collar alone.[1-3,7]

In 1969, with the widespread use of the bucket seat in the USA and the utilisation of the CED at motor racing events, limitations to the SSB began to appear and the design of the first jacket style CED known as the Kendrick Extrication Device (KED) came into being. Studies quickly established superior cervical spine immobilisation of the jacket CEDs over the SSB[1-2] and a range of new CEDs filtered into the market.

PRIMARY ROLE

The CED is primarily an interim device for use on sitting patients, in a confined or restricted space, to stabilise the cervical spine, whilst taking the patient from the sitting position to a lying position on a Long Spine Board.

In applying the CED, the device will also assist in preventing twisting of the spinal column during extraction,[2] and provides handles on the patient to aid in their removal.

INDICATIONS FOR USE

The CED is indicated for use as a cervical splinting device when the patient is found in a confined or restricted space, and where:[9-11, 14-15]

1. **Signs & symptoms of potential or actual spinal cord / column injury exist.**

OR

2. **Mechanism of Injury exists without signs & symptoms of spinal cord / column injury AND the patient has one or more of the following:**
    - **Altered Conscious State.**
    - **Alcohol / Drug Consumption.**
    - **Trauma above the Clavicles**
    - **Distracting Injury or event.**
    - **Modifying Factors (including communication barriers caused by language barriers, extremes of age, intellectually disabilities).**

Other uses of the CED include: Lifting Device.
Pelvic Splint.
NOF Splint.
Extremity Splint.

CONTRA-INDICATIONS FOR USE

The CED is contra-indicated for use as a cervical splint when:

- The patient is actual time critical,

  AND

- The application of the CED will **DIRECTLY** delay transport to a trauma centre or appropriate hospital, and has no additional benefit in the extraction of the patient.

LIMITATIONS OF USE

The CED has a number of limitations when used as a cervical splint:

1. Can be time consuming to fully apply, varying upwards from 4 minutes.

2. Whilst providing excellent cervical spine immobilisation,[1-3] the CED provides only moderate thoracic / lumbar support.

3. Can be difficult to insert when:

   - Access to torso is limited.

     

   - Patient is sitting, but inclined on side at an angle greater than 30°.

     

   - Patient is sitting, but inclined backwards at an angle greater than 30°.

     

PRECAUTIONS OF USE

When applying the CED, the following precautions should be considered:

1. Chest straps too tight can interfere with respiratory effort.
2. Groin straps not placed within the gluteal fold, or not sufficiently secure, may result in the CED sliding up during the extrication potentially causing neck stretch.
3. Incorrect or inappropriate head padding can lead to cervical spine hyperextension or hyperflexion.[12]

SELECTING A CED

When evaluating a CED for purchase and introduction into service, key selection criteria should include:

- Jacket style design to allow for use in bucket style seats and for confined spaces.
- Shoulder straps to prevent downward movement of the CED.
- Lateral chest straps to prevent sideway twisting of the CED.
- Groin straps to stop upward siding of the CED. These should be positioned centrally on the rear of the jacket, with buckles located as close to the centre anteriorly as possible so that the groin straps are properly positioned in the gluteal fold and not on the pelvic girdle.
- Firm head padding to properly pad the occipital region to prevent hyperextension of the cervical spine.
- Lumbar padding to maintain natural curvature of the lumbar spine.
- Head straps that properly secure to the jacket to immobilise the head to the jacket.

APPLICATION OF A NIEJ - CERVICAL SPLINT

Training Requirements:	**3 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x NIEJ**

The following application provides a guide to applying the recently designed NEANN Immobilisation & Extraction Jacket (NIEJ), but the application process can be adopted for other jacket style devices on the market.

APPLICATION OF A NIEJ - CERVICAL SPLINT

PRODEDURE

1. Following the patient assessment by Officer 1 (pg 43 - 44) Officer 3 continues Manual In-Line Stabilisation of the patient's head (pg 55 - 60) and maintains this during application of NIEJ, even once the Cervical Collar is applied. Remember a Cervical Collar will provide only 50% immobilisation of the cervical spine.[1-2]

2. Officer 1 selects and apply a correctly fitting Cervical Collar (pg 73 - 80) .

3. Officer 1 or 2 removes all bulky items from the patient's chest and pelvic pockets to prevent discomfort of NIEJ once it is attached to the torso.

4. Officer 1 removes the NIEJ from the carry bag. **DO NOT** undo any straps on the jacket at this point, but ensure all straps are firmly held in place for insertion.

5. Officer 1 lays the carry bag on the vehicle or ground, and places the yellow lumbar support, blue groin pads, red head pads and black head straps on the carry bag for ease of access and location of items later.

APPLICATION OF A NIEJ - CERVICAL SPLINT

6. Either Officer slightly rotates the back of the seat downwards or alternatively, leans the patient's torso slightly forward of the seat. This will allow easy insertion of the NIEJ.

   Insert the NIEJ at a 45º angle behind patient with buckles facing outwards from patient. Once in behind the patient's torso, straighten up the NIEJ and ensure it is correctly centred behind patient.

7. Insert lumbar support in curve of the patient's lumbar spine. This will assist in maintaining the natural curvature of the patient's lumbar spine, and help prevent lower back pain following immobilisation. Alternatively, a folded towel can be used if lumbar support is misplaced.

   Lean the patient back into NIEJ.

8. Officers 1 & 2 slide the NIEJ into a position so that top of the NIEJ's chest flaps are no higher than the top of the patients armpits.

9. Officer 1 or 2 (whoever has greatest access to the groin straps) releases the groin straps from back of NIEJ. This Officer holds both groin straps together ensuring straps are not twisted. This Officer pulls the groin straps down between patient and chest flap. This Officer slides the groin straps under one of the patient's legs, zig zagging straps under the leg and bottom until straps are in the patient's gluteal fold. It is essential that the straps are in the patient's gluteal fold to ensure proper stability of NIEJ and to prevent loosening of straps when the patient's leg position changes during the extraction.

APPLICATION OF A NIEJ - CERVICAL SPLINT

10. Officers 1 & 2 raise the patient's arms to shoulder height, then position chest flaps against patient's chest. Avoid raising arms higher than shoulders as this may cause upper spinal column movement.

11. Officers 1 & 2 apply the green shoulder straps. These shoulder straps will prevent NIEJ sliding down body. Select one of the following two methods:

Cross Strapping

This is the preferred method of application.

Release green shoulder strap from holder. Bring left sided green strap over the patient's left shoulder and connect to green strap female buckle on right side of chest flap. Place hand between strap & patient's chest, adjust strap using feed & pull until a firm sensation is felt on hand. Bring right sided green strap over patient's right shoulder and connect to green strap female buckle on left side of chest flap. Place hand between strap & chest, adjust strap using feed & pull until a firm sensation is felt on hand.

Vertical Strapping

Release green shoulder strap from holder. Bring left sided green strap over patient's left shoulder and connect to green strap female buckle on left side of chest flap. Place hand between strap & chest, adjust strap using feed & pull until a firm sensation is felt on hand. Bring right sided green strap over patient's right shoulder and connect to green strap female buckle on right side of chest flap. Place hand between strap & chest, adjust strap using feed & pull until a firm sensation is felt on hand. This vertical strapping method is preferred when shoulder injuries or respiratory distress is present.

APPLICATION OF A NIEJ - CERVICAL SPLINT

12. Officer 2 applies yellow chest strap. To apply, release yellow strap from holder. Connect yellow strap buckles. Place hand between yellow strap & chest, adjust strap using feed & pull until a firm sensation is felt on hand. Beware of over tightening as it may result in respiratory compromise.[6]

13. Officer 2 applies red chest strap. To apply, release red strap from holder. Connect red strap buckles. Place hand between red strap & chest, adjust strap using feed & pull until a firm sensation is felt on hand. Beware of over tightening strap as it may result in pressure on the abdominal organs.

14. Officer 1 & 2 connect groins straps by:

Slide a blue groin pad onto each black groin strap and slide into sub pubic groin area. Pads will improve comfort for the patient when lifting the NIEJ.

Connect each of the black groin straps to it's appropriate buckle. Place hand between strap and patients abdomen. Adjust each strap using feed & pull until a firm sensation is felt on hand.

APPLICATION OF A NIEJ - CERVICAL SPLINT

15. Officer 2 rechecks green, yellow, red and black straps to confirm comfortable but firm fit.

It is essential that before immobilising the patient's head to the NIEJ, ensure the NIEJ cannot move up, down, left or right. If movement cannot be prevented then two choices are available:

- If the NIEJ is to be used as a lifting device, **DO NOT** immobilise the head to the NIEJ as cervical spine movement or stretching may occur, with potentially disastrous results. In this case bypass steps 16 to 20.
- If the NIEJ is to be used as a cervical splint, immobilise the head (as per steps 4 to 16), but **DO NOT** lift using the NIEJ, otherwise cervical spine movement or stretching may occur, with potentially disastrous results.

16. Begin application of the head section by initially ensuring the patient's head is still in the neutral in-line position. In general, adults require between 4 cm to 7 cm of padding at the occipital skull to prevent hyperextension of the cervical spine.[12] Padding at the patient's neck region when using semi-rigid Cervical Collars is not required and may place unwanted pressure on the patient's cervical spine.

17. Officer 1 selects and velcros together a sufficient number of red head pads needed to completely fill the space between the patient's occiput and the NIEJ. Carefully slide and velcro the padding onto the NIEJ, avoiding movement of the patient's head. This will prevent hyperextension of the cervical spine.[12] Alternatively, a folded towel can be used if head pads are misplaced (use a small towel folded to the correct thickness).

18. Whilst Officer 3 continues to maintain manual in-line stabilisation, Officer 1 folds the head flaps inwards placing them alongside the flat lateral planes of the patient's head. Once the head flaps are in place, Officer 3 maintains manual in-line support with their hands on the outside of the head flaps.

APPLICATION OF A NIEJ - CERVICAL SPLINT

19. Officer 2 applies the 25mm Collar Strap by attaching side hook velcro tabs to head flaps with sliders level with front of head flaps. Tighten strap by ensuring foam pad is centred on the Cervical Collar (away from chin support), placing thumbs on centre of strap, and pulling both ends with equal pressure. Place only enough pressure to prevent movement, but not to deform Collar or place pressure on the jaw line. Velcro into place. Under no circumstances is pressure to be placed on the patient's jaw line as this may clamp the mouth shut, compromising the airway.

    If no Cervical Collar can be applied, tighten strap by ensuring pad centered on maxilla just under nostrils, placing thumbs on center of strap, and pulling both ends with equal pressure. Velcro into place.

20. Officer 2 applies 50mm Forehead Head Strap by attaching side hook velcro tabs to head flaps with sliders level with front of head flaps, ensuring forehead head strap bottom aligns with bottom of patients eyebrow's. Tighten strap ensuring foam pad centered on forehead, placing thumbs on center of forehead, and pulling both ends with equal pressure. Velcro into place.

    Alternatively, if head straps are not available, crepe bandages or Coban™ can be used.

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21. Extricate the patient from their position by sliding, lifting and/or manoeuvreing the patient onto a Long Spine Board.

22. Once the patient is lying supine on the Long Spine Board, carefully straighten the patient's legs. If the groin straps are correctly in position, no tightening in the groin area should be felt. Straps can be loosened, but not removed, if increasing tension is however felt.

23. Immobilise patient still wearing NIEJ to a Long Spine Board (pg 208 - 217).[13]

24. Provide necessary additional treatment.

APPLICATION OF A KED - LIFTING DEVICE

Training Requirements:	**3 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Kendrick Extrication Device (KED)**

The following application provides a guide to applying the KED as a lifting device.

Since the KEDs inception in 1969, ongoing research into spinal care has led to a range of modifications to immobilisation requirements. The KED has failed to keep pace with these changes. Problems include:

- *No shoulder straps to prevent downward sliding of the KED.*
- *Groin straps wrap around the patient's pelvic girdle leading to instability of the KED and allowing it to slide up or move down during lifting or leg movement changes, depending on how the groin straps are applied.*
- *Head padding fails to provide proper padding to maintain neutral cervical spine positioning as it is too soft. It should bereplaced with a towel.*
- *Head straps do not attach securely to the head flaps due to the foam design and should be replaced with tape or a bandage.*

Due to the design of the groin straps, application of the KED should be limited to the following:

- *If the KED is to be used as a lifting device, do not immobilise the patient's head to the KED. With a Cervical Collar on the patient, immobilisation of the cervical to lumbar spine will still provide 50% immobilisation and prevent gross twisting of the spinal column during the extraction.*
- *If the patient requires full cervical immobilisation with the KED, immobilise the patient fully into the KED, but do not use the KED to lift the patient. Lifting with the KED and with the head immobilised to the device will result in either a neck stretch or compression depending on how the groins straps are applied.*

PRODEDURE

1. Following patient assessment by Officer 1 (page 43 - 44), Officer 3 continues manual head stabilisation during application of KED, and until the patient is immobilised to a Long Spine Board (pg 208 - 217).[13] Remember a Cervical Collar will provide only 50% immobilisation of the cervical spine.[1-2] Select and apply a correctly fitting Cervical Collar (pg 73 - 80).

   If appropriate, remove all bulky items from the patient's chest and pelvic pockets to prevent discomfort of KED once it is in place.

APPLICATION OF A KED - LIFTING DEVICE

2. Either Officer slightly rotates the back of the seat downwards or alternatively, leans the patient's torso slightly forward of the seat. This will allow easy insertion of the KED.

   Insert the KED at a 45º angle behind the patient with buckles facing outwards from patient. Once it is in behind patient's back, straighten up the KED and ensure it is correctly centred behind patient.

3. Position the KED so that top of chest flaps are no higher than the top of patient's armpits.

4. Release the groin straps from back of KED. Pull groin straps down between the patient and chest flap, and leave for later attachment.

5. Raise arms to shoulder height, then position chest flaps against patients chest. Avoid raising arms higher than shoulders as this may cause upper spinal column movement. Slide the top of the KED's chest flaps up into the patient's armpits.

6. Apply chest straps. To apply, begin with green strap and release strap from holder. Connect green strap buckle. Place hand between green strap & chest, adjust strap using feed & pull until a firm sensation is felt on hand. Beware of over tightening as it may result in respiratory compromise.[6]

Repeat the same process applying the yellow and finally red strap.

APPLICATION OF A KED - LIFTING DEVICE

7. Re-check chest straps ensuring hand is still able to fit between chest and strap. Over tightening will compromise the patient's respiratory ability.[6]

8. Connect groins straps by:

Slide first groin straps under both legs, pull to opposite side of the patient and drag fully through. Zig zag the strap under opposite leg and bottom and drag forward until strap is in the gluteal fold. It is essential that the strap is in the gluteal fold to ensure proper stability of KED and to prevent loosening of straps when leg position changes during extraction. Connect black groin strap buckle to same side white female buckle. Place hand between strap and patients abdomen. Adjust all straps using feed & pull until a firm sensation is felt on hand.

9. Patient is now ready for extraction onto a Long Spine Board. Padding under the patient's head with a towel may be required to prevent hyperextension.[12] Also remember that the spinal column is only 50% immobilised and that manual in-line stabilisation of the head is still required as movement may still occur until immobilised to the Long Spine Board (pg 208 - 217).[13]

ALTERNATIVE USES OF THE CED

CEDs have a range of alternative uses beyond the use of the device as just a cervical splint. The accepted uses include:

Pelvic Fracture Splint

NOF Fracture Splint

Extremity Fracture Splint

Paediatric Full Spine Immobiliser

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LONG SPINE BOARD

INTRODUCTION

The Long Spine Board (**LSB**) provides one of the most versatile tools available for the prehospital environment allowing for multiple uses including a patient lifting device, transfer platform, patient protection during vehicle cutting, spinal immobilisation, leg or pelvic fracture splint, extrication tool, etc. Whilst there have been many attempts to replace it, no other single device has been as durable or able to perform the many tasks the LSB can undertake.

The first recorded use of a LSB dates back over 6500 years, with history recording patients to have been placed on long wooden boards where they stayed until they were better. Hippocrates (460 - 377 BC) wrote that an unfortunate victim suffering a SCI would be strapped to a Board, held upside down and shaken vigorously until the spine fell back into place.

Modern use of a purpose built LSB is first recorded during the 1850's in Pomona, California. A Board like stretcher with wrought iron handles attached to the underneath of the Board, and shaped very much like coffin lid was introduced for transporting and splinting injured patients. Over the next 100 years, LSBs have continued to develop into an array of shapes made out a range of materials including wood, aluminium, plastic and fibreglass.

The following chapter presents a range of applications of the LSB in the prehospital setting. Before application of the LSB, a patient assessment should be undertaken (page 43 - 44), unless the patient is actual time critical and requires rapid assessment and transport.

INTRODUCTION TO THE LOG ROLL

The log roll technique is one of the most commonly used manoeuvres for moving a patient onto a Long Spine Board (LSB), as there is a current belief that it maintains adequate spine alignment, whether the patient is found in the supine, prone or lateral position. It's popularity is due to the manoeuvre's ability to:

a) Allows removal of the patient's clothing from the anatomical region the patient is lying.
b) Allows the patient to be fully examined including the region upon which the patient is lying.
c) Allows the patient to be rapidly placed onto the LSB.

This gives the log roll the nickname 'Flip-And-Strip'. Difficulties tend to occur in using the log roll when injuries to the chest, pelvis, legs or arms are present. In these cases alternative methods of moving the patient such as the Straddle Lift: Side (pg 115 - 117) or the use of a Scoop Stretcher (pg 194 - 207) should be sought.

In recent times, the log roll has come under increasing scrutiny due to the amount of spinal movement that has been documented in studies.[1-3] Manoeuvres such as the Canadian Log roll or Haines manoeuvre that require an arm to be raised above the head are potentially dangerous to an unstable spinal fracture below the level of the cervical spine due to the thoracic / lumbar sagging,[1] and should therefore be avoided if it is at all possible.

A second method of log rolling that places both arms across the chest also results in thoracic / lumbar sagging, but less that the previous methods.[1-2]

At present the safest techniques, based on current research, is for the patient's arms to be fully extended and placed by the patient's sided with the palms facing inwards.[1, 3] While some sagging will occur, it is minimal and less that other methods currently use.

With this new technique, approximately 10% of people will complain of slight pain in the arms as the patient is rolled onto the LSB. This pain is temporary with no lasting effects.[4] To further assist with the proper alignment and in reducing spinal column movement during the manoeuvre, the patient should be requested to stiffen up until placed on the LSB.

Finally there is evidence that other methods of moving the patient onto the LSB i.e. the Straddle Lift: Side (pg 115 - 117) causes less movement on the healthy volunteer than the log roll.[4-5] Alternatively the use of a good quality rigid Scoop Stretcher (pg 194 - 207) will provide less movement than a log roll, if used in the correct setting.

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LOG ROLL - 4 PERSON

The following method of log roll which uses the arms by the side to splint the body, has been shown through x-ray studies to be the safest log rolling method currently available.[1] *Techniques which elevate the arms above the head or place the arms across the chest result in thoracic / lumbar spine sagging,*[1-3] *and should therefore be avoided whenever possible.*

In this procedure, the Officer's limb closest to the patient's head will be referred to as the Officer's upper limb, and the Officer's limb closest to the patient's feet will be referred to as the Officer's lower limb.

Training Requirements:

4 x Staff
1 x Patient
1 x Cervical Collar
1 x Long Spine Board (LSB)
1 x Blanket
1 x Towel
1 x Hand / Wrist Airsplint

Procedure

Step 1

While Manual In-Line Stabilisation is maintained by Officer 1 at the patient's head (pg 55 - 60), Officer 2 applies a Cervical Collar (pg 73 - 80), and places the LSB alongside the Officer 1. The Manual In-Line Stabilisation is maintained until full spine immobilisation is achieved as a Cervical Collar will at best provide only 50% immobilisation.[5-10]

Officer 2 kneels at the patient's mid-torso, straightens the patient's arms with the patient's palms facing in next to the torso. Palm-out may result in elbow joint damage during the roll. Officer 2 then grasps the far side of the patient at the shoulder and just above the elbow.

Officer 2 at the torso is in charge and sets the pace for the log roll since they lift most of the weight.

Officer 3 kneels next to Officer 2 and grasps the patient's pelvic bone. Officer 3's lower hand grasps both trouser cuffs at the ankles. If shorts or skirt are being worn, tie a figure-of-eight around the ankles with a triangular bandage and grasp the triangular bandage. Officer 3 also places their lower foot up against the patient's legs, just below the knees for the patient's lower legs to roll onto during the log roll, to prevent the patient's pelvis drooping.

LOG ROLL - 4 PERSON

Officer 4 kneels on the opposite side of the patient at the patient's pelvic level. Officer 4's upper hand is placed on the patient's upper arm and Officer 4's lower hand is placed on the patient's upper leg.

Step 2

With Officer 2 at the chest in charge, the patient is carefully log rolled until right angles to the ground.

Officer 1 at the head watches the patient's torso turn and maintains manual support of the head, rotating it exactly with the torso.

Officer 3 at the patient's legs assists with rotation of the patient's torso and takes the weight of the patient's pelvis, again watching the torso. The patient's lower legs roll onto Officer 2's lower foot to prevent pelvic drooping.

Step 3

Before rolling the patient down onto the LSB, and if appropriate, cut away the clothing covering the patient's back and examine this area for injuries.

A folded blanket running the length of the patient's posterior body (head to feet) can be placed against the patient to improve comfort after the patient is laid back on the LSB.[15-18] This will also assist in the later removal of the patient off the LSB.

Step 4

Officer 4 slides the LSB in against the patient's back and elevates the side of the LSB furthest from the patient at a 45º angle towards the patient's back. Align the patient's shoulders level with the shoulder markings on the LSB.

LOG ROLL - 4 PERSON

Step 5

Lower the patient and elevated side of the LSB down onto the ground together, with the LSB assisting to maintain alignment of the patient, again with Officer 2 at the patient's torso setting the pace. The LSB therefore acts a body splint for lowering the patient.

Step 6

Keeping the patient in the neutral in-line position, gently adjust the patient's position sideways so that the patient is centred on the LSB.

Step 7

Apply appropriate padding under the patient's head and lumbar spine to maintain proper alignment of the spinal column[11] and for comfort.[12] Immobilise the patient onto the LSB for transport (pg 209 - 217).[19]

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LOG ROLL - 2 PERSON

The following method of log roll which uses the arms by the side to splint the body, has been shown through x-ray studies to be the safest log rolling method currently available.[1] Techniques which elevate the arms above the head or place the arms across the chest result in thoracic-lumbar spine sagging,[1-3] and should therefore be avoided whenever possible.

The 2 person log roll has not been examined in any x-ray studies and therefore it's use should be used only when other proven methods of placing a person onto the Long Spine Board (LSB) are not possible.

In this procedure, the Officer's limb closest to the patient's head will be referred to as the Officer's upper limb, and the Officer's limb closest to the patient's feet will be referred to as the Officer's lower limb.

Training Requirements:	**2 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Long Spine Board (LSB)** **1 x Triangular Bandage** **1 x Blanket** **1 x Towel** **1 x Hand / Wrist Airsplint**

Procedure

Step 1

While Manual In-Line Stabilisation is maintained by Officer 1 at the patient's head (pg 55 - 60), Officer 2 applies a Cervical Collar (pg 73 - 80), and places the LSB alongside the Officer 1. The Manual In-Line Stabilisation is maintained until full spine immobilisation is achieved[1] as a Cervical Collar will at best provide only 50% immobilisation.[2-7]

Officer 2 now kneels at the patient's mid-torso on the side to which the patient is to be log rolled. The patient's legs are tied together and the knees bent up to a 90º angle.

LOG ROLL - 2 PERSON

Step 2

The patient's arms are extended beside their torso with their palms facing inwards.[8-10] Officer 2's upper arm grasps the far side of the patient at the shoulder.

Officer 2's lower arm grasps the patient's hip just distal of the wrist and runs their arm along the patients upper legs which will help assist with the log roll.

Officer 2 also positions their lower foot so that on log rolling the patient, the patients knees will rest of Officer 2's foot to reduce the patient's pelvis drooping.

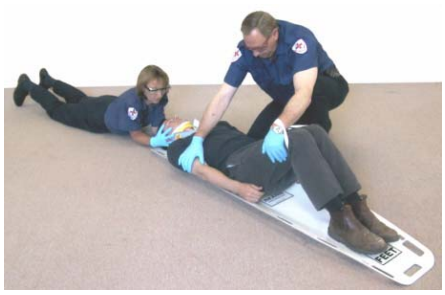
Step 3

The patient is carefully log rolled until they are at right angles to the ground. Officer 2 at the patient's torso is in charge and sets the pace (since he they have bear most of the weight). Officer 1 at the head watches the torso turn and maintains neutral in-line support of the head, rotating it exactly with the torso.

Before rolling the patient down onto the LSB, and if appropriate, cut off the clothing covering the patient's back and examine this area for injuries.

Step 4

A folded blanket running the length of the patient's posterior body (head to feet) can be placed against the patient to improve comfort after the patient is laid back on the LSB.[13-16] This will also assist in removing the patient from the LSB. Officer 2 slides the LSB in against the patient's back and elevates the side of the LSB furthest from the patient at a 45º angle towards the patient's back. Align the patient's shoulders level with the shoulder markings on the LSB.



Step 5

Lower the patient and elevated side of the LSB down onto the ground together, with the LSB assisting to maintain alignment of the patient, again with Officer 2 at the patient's torso setting the pace. The LSB therefore acts a body splint for lowering the patient.

LOG ROLL - 2 PERSON

Straighten out the patient's knees. Apply appropriate padding under the patient's head and lumbar spine to maintain proper alignment of the patient's spinal column[11] and for comfort.[12] Immobilise the patient on the LSB for transport (pg 209 - 217) .[17]

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LOG ROLL - 4 PERSON PRONE

When the patient presents in a semi-prone position (as shown below), a method similar to that for a supine patient is used for the log roll, incorporating the same initial alignment of the patient's limbs.[1-3]

Points To Remember:

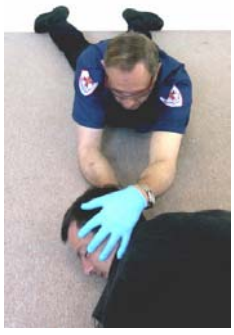
1. *The patient is rolled away from the direction in which his face initially points.*
2. *A Cervical Collar cannot be applied as the head will not be re-aligned with this manoeuvre.*
3. *Remaining in the prone position will limit the patient's ability to breath due to continual pressure on the rib cage.*
4. *Arching of the spine will occur with each of the patient's breaths whilst in the prone position.*
5. *ALS skills are harder to achieve in the prone position.*

In this procedure, the Officer's limb closest to the patient's head will be referred to as the Officer's upper limb, and the Officer's limb closest to the patient's feet will be referred to as the Officer's lower limb.

Training Requirements:	**4 x Staff** **1 x Patient** **1 x Long Spine Board (LSB)** **1 x Blanket** **1 x Towel** **1 x Hand / Wrist Airsplint**

Procedure

Step 1



Officer 1 at the head positions themself at a 45º angle to the patient. Manual In-Line Stabilisation is achieved with Officer 1 placing their distal hand under the patient's head and their proximal hand on top of the patient's head.

A Cervical Collar cannot be placed into position as with this log roll, the head cannot be re-aligned.

Officer 2 kneels at the patient's mid-torso on the side that the patient is to be rolled and extends the patient's arms down the torso with the patient's palms facing inwards, then grasps the far side of the patient at the shoulder and just above elbow.

LOG ROLL - 4 PERSON PRONE

Officer 3 kneels at the patient's knees, grasps the hip just distal to the wrist and tightly grasps both trouser cuffs at the ankles. If shorts or a skirt are being worn, tie a figure-of-eight around the ankles with a triangular bandage and grasp the triangular bandage. Officer 3 also places their lower foot up against the patient's legs, just below the knees for the patient's lower legs to roll onto during the log roll, so as to prevent the patient's pelvis drooping.

Officer 4 kneels on the opposite side of the patient at pelvic level. Officer 4's upper hand is placed on the patient's upper arm and Officer 4's lower hand is placed on the patient's upper leg.

Step 2

The patient is carefully log rolled until at right angles to the ground. Officer 2 at the torso is in charge and sets the pace (since Officer 2 bears most of the weight).

Officer 1 at the head watches the torso turn and maintains Manual In-Line Stabilisation of the head, rotating it exactly with the torso.

Officer 3 at the legs assists with rotation of the patient's torso by taking the weight of the pelvis, again watching the torso. The patient's lower legs roll onto Officer 3's lower foot to prevent pelvic drooping.

Step 3

Before rolling the patient down onto the LSB, and if appropriate, cut away the clothes covering the patient's front and examine this area for injuries.

A folded blanket running the length of the patient's body (head to feet) can be placed against the patients front to improve comfort after the patient is laid back on the LSB.[4-7] This will also assist in the later removal of the LSB.

Officer 4 slides the LSB in against the patient's back and elevates the side of the LSB furthest from the patient at a 45º angle towards the patient's back. Align the patient's shoulders level with the shoulder markings on the LSB.

LOG ROLL - 4 PERSON PRONE

Step 4

Now lower the patient and the LSB down onto the ground together, with the LSB assisting to maintain alignment of the patient, again with Officer 2 at the patient's torso setting the pace.

Step 5

Keeping the patient in the neutral in-line position, gently adjust the patient's position sideways until centred on the LSB.

Immobilise the patient onto the LSB for transport (pg 209 - 213).[8]

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LOG ROLL - 5 PERSON PRONE 180^0

When the patient presents in a semi-prone position (as shown), the Officers may wish to carry out the following manoeuvre which rolls the patient onto their back. It incorporates the same initial alignment of the patient's limbs as other log rolls - arms by the patient's side.[1-3]

Points To Remember:

1. *The patient is log rolled away from the direction in which the patient's face initially points.*
2. *A Cervical Collar is not applied until the patient is in the supine position on the LSB.*
3. *With this log roll, if appropriate, cut off the clothes covering the patient's back and examine it before the log roll begins.*
4. *Remaining in the prone position will limit the patient's ability to breath due to pressure on the rib cage.*
5. *Arching of the spine will occur with each of the patient's breath whilst in the prone position.*

In this procedure, the Officer's limb closest to the patient's head will be referred to as the Officer's upper limb, and the Officer's limb closest to the patient's feet will be referred to as the Officer's lower limb.

Training Requirements:	**5 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Long Spine Board (LSB)** **1 x Blanket** **2 x Towel** **1 x Hand / Wrist Airsplint**

Procedure

Step 1

Officer 1 positioned at the patient's head, positions their arms in anticipation of the full rotation that will occur. Officer 1 positions at a 45º angle to the patient, with arms placed so that the elbow to the side the patient will be rolled onto is in line with the patient's inner shoulder to roll. Manual In-Line Stabilisation is achieved Officer 1 placing their distal hand under the patient's head and their proximal hand on top of the patient's head.

Officer 2 kneels at the patient's mid-torso, on the other side to which the patient is to be rolled, and extends the patient's arms down the patients torso. Officer 2 places their upper hand under the patient's shoulder and the lower hand under the patient's abdominal region level with lower ribs.

LOG ROLL - 5 PERSON PRONE 180º

Officer 3 kneels on the same side as Officer 2 at the patient's thigh, slides their upper hand under the patient's pelvic region, and lower hand under patient's upper leg. Bandaging the legs together may assist with the log roll. Officer 3 also places a rolled up towel against the patient's leg just below the knees for the lower legs to roll onto during the log roll to prevent pelvic drooping.

Officer's 4 & 5 kneel on the side to which the patient is to be rolled and place a blanket over the posterior of the patient for padding on the LSB to improve comfort[6-9] & to assist later LSB removal.

Officer 4 kneels at the patient's mid torso grasping the patient's opposite side shoulders and opposite lower chest. Officer 5 kneels at the patient's thigh grasping the patient's opposite pelvis and opposite mid femur.

A LSB is rested on the knees of Officer 4 & 5 so that the side of the LSB furthest from the patient is elevated at an angle of 45º. The LSB's shoulder marking is aligned with the patient's shoulders.

Step 2

The patient is carefully log rolled until the patient's back is placed on the LSB. Officer 2 at the patient's torso is in charge and sets the pace as Officer 2 bears most of the patient's weight.

Officer 1 at the patient's head watches the patient's torso turn and maintains the current position of the head, rotating it exactly with the patient's torso. Only after the patient is completely log rolled onto the their back is the patient's head then slowly re-aligned to the neutral in-line position unless contra-indicated (pg 51).

Officer's 2 & 4 both assist with rotation of the patient's torso. Officer's 3 & 5 both assist with rotation of the patient's pelvis, ensuring the patient's pelvis rotates in-line with the patient's torso. The patient's lower legs are rolled onto the towel to prevent the patient's pelvis drooping.

LOG ROLL - 5 PERSON PRONE 180º

Step 3

Whilst rotating the patient, Officer's 4 & 5 steadily shuffle backwards until the LSB and patient are flat on the ground.

Keeping the patient in the neutral in-line position, gently adjust the patient's position sideways until centred on the LSB.

Step 4

Officer 1 now re-aligns the patients head into the neutral in-line position unless contra-indicated (page 51).

Step 5

Apply appropriate padding under the patient's head and lumbar spine to maintain proper alignment of the spinal column[4] and for comfort.[5]

A Cervical Collar is now applied (pg 73 - 80), and the patient immobilised to the LSB for transport (pg 209 - 213).[10]

LOG ROLL - 5 PERSON PRONE 180º

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STRADDLE LIFT - SIDE

The Straddle Lift - Side is the preferred technique for placing a patient onto a Long Spine Board (LSB)[1] and can used with the patient found in either the supine, prone or lateral positions. It is especially useful for patients with injuries preventing a log roll or where the Scoop Stretcher cannot be applied. The Straddle Lift - Side can also be used very effectively on rough ground or uneven surfaces that would again prevent the application of the Scoop Stretcher or the use of a log roll. From an OH&S point of view, the Straddle Lift appears to offer a very safe lifting technique when performed correctly[1].

Points To Remember:

1. *When lifting, Officers elbow should rest on their legs to remove the strain from the Officers' back.*
2. *If applying the LSB, the patient needs to be lifted only 2 - 5 cm off the ground.*
3. *Padding using blankets is recommended for LSB comfort and to reduce pressure sores.[2-5] Blankets should be placed on the LSB before insertion.*
4. *If using a Scoop or a thick LSB, the patient will need to be lifted slightly higher for the patient to clear the frame.*

In this procedure, the Officer's limb closest to the patient's head will be referred to as the Officer's upper limb, and the Officer's limb closest to the patient's feet will be referred to as the Officer's lower limb.

Training Requirements:	**6 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Long Spine Board (LSB)** **1 x Blanket** **1 x Towel** **1 x Hand / Wrist Airsplint**

Procedure

Step 1

Place the LSB above the patient's head and in-line with the patient's body. Alternatively, the LSB can be slid under from the patient's foot end if access above the patient's head is not possible. Officer 1 positions at the patient's head and squats down on their knees with one leg on either side of the LSB so that the LSB can be slid through Officer 1's legs. Manual In-Line Stabilisation of the patient's head (pg 55 - 60) is performed by Officer 1 with elbows resting on their legs for stability. A Cervical Collar is also applied (pg 73 - 80) The Manual In-Line Stabilisation is maintained until full spine immobilisation is achieved[1] as a Cervical Collar will at best provide only 50% immobilisation.

STRADDLE LIFT - SIDE

Officers 2 & 3 kneel on either side of the patient's torso. Officers 2 & 3 pull the patient's clothes at the shoulders firmly to the sides with their lower hands to allow their upper hand to easily slide under patients shoulders. **DO NOT** lift patient's shoulder upward during this procedure. Officer 2 & 3's upper elbow should rest on their upper thigh to avoid strain on the Officer's back during the lift. Officer's 2 & 3's lower hand should be placed under the patient's lumbar spine.

Officer's 4 & 5 kneel on either side of the patient's mid thigh. Officers 3 & 4 pull the patient's clothes at the patient's bottom firmly sideways with lower hand to allow their upper hand to slide easily under patient's bottom. **DO NOT** lift patients bottom upward. Officer's 4 & 5's upper elbow should rest on their upper thigh to avoid strain on their back during the lift.

Officer 6 is positioned above the patient's head to slide the LSB into place. Before inserting the LSB, Officer 6 should place a blanket onto the LSB for improved comfort[2-5] (taped at the foot end to ensure the blanket stays in place during LSBs insertion under the patient). A hand/wrist airsplint should be placed on top of the blanket where the patient's lumbar spine will be positioned.

Step 2

With Officer 1 at the patient's head in-charge, Officers 1 to 5 lift the patient by slightly flexing their arms upwards, lifting the patient only enough for Officer 6 to slide the LSB under the patient.

Step 3

Officer 6 then slides the LSB underneath the patient. The curve of the LSB will allow the LSB to slide correctly under the patient aligned with the LSB markings.

The patient is then immobilised to the Board for transport (pg 209 - 213).[6]

STRADDLE LIFT - SIDE

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STRADDLE LIFT - ABOVE 4 PERSON

The Straddle Lift - Above is a technique to place a patient onto a Long Spine Board (LSB) where space or the number of rescuers is limited, and can be used with the patient found in either the supine, prone or lateral positions. It is especially useful in confined spaces where there is insufficient room to perform other manoeuvres such as Straddle Lift - Side, log roll or to apply the Scoop Stretcher. The Straddle Lift - Above can also be used very effectively on rough ground or uneven surfaces that would again prevent the application of the Scoop Stretcher or the use of a log roll.[1] From and OH&S point of view, the Straddle Lift appears to offer a very safe lifting technique when performed correctly.

Points To Remember:

1. *When lifting keep the arms and back straight, and use your quadriceps to do the lift.*
2. *When applying the LSB, the patient needs to be lifted only 2 - 5 cm off the ground.*
3. *Padding using blankets is recommended for LSB comfort and to reduce pressure sores.[2-5] Blankets should be placed on the LSB before insertion.*
4. *If using a Scoop Stretcher or a thick LSB, the patient will need to be lifted slightly higher for the patient to clear the frame.*

Training Requirements:	**4 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Long Spine Board (LSB)** **1 x Blanket** **1 x Towel** **1 x Hand / Wrist Airsplint**

Procedure

Step 1

Place the LSB above the patient's head and in-line with the patient's body. Alternatively, the LSB can be slid under from the patient's foot end if access above the patient's head is not possible. Officer 1 positions at the patient's head and squats down on their knees with one leg on either side of the LSB so that the LSB can be slid through Officer 1's legs. Manual In-Line Stabilisation of the patient's head (pg 55 - 60) is performed by Officer 1 with elbows resting on their legs for stability. A Cervical Collar is also applied (pg 73 - 80) The Manual In-Line Stabilisation is maintained until full spine immobilisation is achieved[1] as a Cervical Collar will at best provide only 50% immobilisation.

STRADDLE LIFT - ABOVE 4 PERSON

Officer 2 is positioned above the patient's head to slide the LSB into place. Before inserting the LSB, Officer 6 should place a blanket onto the LSB for improved comfort[2-5] (taped at the foot end to ensure the blanket stays in place during LSBs insertion under the patient). A hand/wrist airsplint should be placed on top of the blanket where the patient's lumbar spine will be positioned.

Step 2

Officer 3 straddles over the patient's torso and faces side-on to the patient. Officer 3 then squats down and places their hands underneath the patient's armpits. Officer 3's arms should rest on their inner legs with their back and arms kept straight.

Officer 4 (at the same time as Officer 3) straddles over the patient's upper legs and faces the same way as Officer 3. Officer 4 then squats down and places their hands underneath the patient's bottom. Officer 4's arms should rest on their inner legs with their back and arms kept straight.

Step 3

With Officer 3 in charge (as Officer 3 bears most of the weight), Officer 1 at the head lifts by slightly flexing both their elbows. Officer 3 at the patient's chest and Officer 4 at the patient's pelvis keep their arms and backs straight and lift the patient approximately 2 - 5 cm of the ground by flexing their quadriceps only.

Officer 2 then slides the LSB underneath the patient. The curve of the LSB will allow the LSB to slide correctly under the patient, aligning the LSB shoulder markings with the patient's shoulders.

Step 4

The patient is then immobilised to the LSB for transport (pg 209 - 213).[6]

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STRADDLE LIFT - ABOVE 2 PERSON

The Straddle Lift - Above (2 Person) is a technique to place a patient onto a Long Spine Board (LSB) used on the non-suspected spinal patient where space or the number of Officers is limited. The technique can be used with the patient found in either the supine, prone or lateral positions. It is especially useful for medical patients in confined spaces where there is insufficient room to perform other manoeuvres such as Straddle Lift - Side, log roll or to apply the Scoop Stretcher. The Straddle Lift - Above (2 Person) can also be used very effectively on rough ground or uneven surfaces that would again prevent the application of the Scoop Stretcher or the use of a log roll.[1] From and OH&S point of view, the Straddle Lift appears to offer a very safe lifting technique when performed correctly.[1]

Points To Remember:

1. *When lifting keep the arms and back straight, and use your quadriceps to do the lift.*
2. *When applying the LSB, the patient needs to be lifted only 2 cm off the ground.*
3. *Padding using blankets is recommended for LSB comfort and to reduce pressure sores.[2-5] Blankets should be placed on the LSB before insertion.*

Training Requirements:	**2 x Staff** **1 x Patient** **1 x Long Spine Board (LSB)** **1 x Blanket** **1 x Pillow** **1 x Hand / Wrist Airsplint**

Procedure

Step 1

Officer 1 places the LSB above the patient's head in-line with the patients body. Officer 1 positions themself beside the LSB.

Step 2

Officer 2 straddles the patient's torso facing Officer 1, squatting down and is positioned at the patient's torso and places a pillow under the patient's head (if non trauma) or towel (if trauma). Officer 2 supports the patient's head as Officer 1 slides the LSB under the patient's head.

STRADDLE LIFT - ABOVE 2 PERSON

Step 3

Officer 2 now repositions their hands underneath the patient's armpits. Officer 2's arms should rest on their inner legs, with their back and arms kept straight.

Officer 2 lifts the patient's torso by slightly flexing their quadriceps, but only enough to slide the LSB underneath the patient's torso Officer 1 stops sliding the LSB when it touches the patient's bottom. The curve of the LSB will allow the LSB to slide correctly aligned under the patient.

Step 4

Officer 2 now moves down to the patient's pelvis and straddles the patient, squatting down and placing their hands underneath the patient's bottom. Officer 2's back and arms are kept straight.

Officer 2 then lifts the patient's pelvis by slightly flexing quadriceps. Officer 1 then slides the LSB underneath the patients bottom and legs until the patient's shoulders are correctly aligned with the shoulder markings on the LSB.

The patient is then secured to the LSB for safety during transport.

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BACKBOARDING THE STANDING PATIENT

Studies show that approximately 17 - 25% of patients with spinal injuries are walking at the scene of the motor crash.[1-3] *The following technique shown, which is often referred to as the 'Standing Long Board', allows Officers to place the patient in the lying position with little movement of the spine when compared to other methods currently practiced. Either a Long Spine Board (LSB) or Scoop Stretcher can be used for this procedure. It should also be noted that a patient in a standing position will still be up to 5 cm shorter as the weight of the head and torso compress the patient's vertebra together. It is therefore essential that the patient be placed in a supine position as soon as possible to uncompress the spinal column.*

The Standing Long Board technique is not just limited to use in the traumatic SCI patient, but can also be used with other patients such as those with back pain or other injuries who find it too painful to get to a lying position without assistance.

By reversing the procedure, the Standing Long Board is an effective way of standing a patient up from the lying position and uses a safe lifting technique. Such cases may include the 'floor-to-bed', chronic C.V.A. or M.S. patient who has fallen and simply requires assistance to stand up.

Training Requirements:	**3 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Long Spine Board (LSB)** **1 x Blanket** **1 x Towel** **1 x Hand / Wrist Airsplint**

Procedure

Step 1

Officer 2 maintains Manual In-Line Stabilisation (pg 55 - 60) until the patient is properly immobilised onto the LSB[2-5, 11] Officer 1 applies a Cervical Collar (pg 73 - 80), The Manual In-Line Stabilisation is maintained as best as possible until full spine immobilisation is achieved[11] as a Cervical Collar will at best provide only 50% immobilisation[2-5].

Officer 1 then inserts a LSB behind the patient.

BACKBOARDING THE STANDING PATIENT

Step 2

Officer 3 inserts blanket between patient and the LSB for improved patient comfort,[6-10] and places a towel for padding between the patient's head and LSB as required to prevent hyperextension of the patient's head.

Step 3

Officers 1 & 3 stand on either side of the patient, with each Officer placing their inner arm under the patient's armpits. Officers 1 & 3 grip the handles of the LSB slightly higher than armpits. This will help prevent the patient sliding down the LSB when the LSB is lowered. Officers 2 & 3's other hand should hold the LSB at the top handle to give additional support and stability whilst the LSB is lowered to the ground.

Step 4

Officers 1 & 3 slowly the lower the LSB backwards until the LSB is on the ground.

Step 5

Finally immobilise the patient to the LSB for transport (pg 209 - 213).[11]

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BACKBOARDING THE SITTING PATIENT

The following technique allows the Officers to place a patient in the sitting position onto a Long Spine Board (LSB) with less movement or stress placed on the spinal column when compared to other manoeuvres currently practiced.

Training Requirements:	**3 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Long Spine Board (LSB)** **1 x Blanket** **1 x Towel** **1 x Hand / Wrist Airsplint**

Procedure

Step 1

With Officer 1 maintaining Manual In-Line Stabilisation of the head (pg 55 - 60), Officer 2 applies a Cervical Collar to the patient (pg 73 - 79). If possible, Officer 1 maintains Manual In-Line Stabilisation until the patient is properly immobilised onto the LSB, as a Cervical Collar is inadequate to immobilise the cervical spine.[2-5]

Step 2

Officer 2 inserts the LSB behind the patient.

BACKBOARDING THE SITTING PATIENT

Step 3

Officer 3 places a blanket between the LSB & patient for improved comfort when lying on the LSB.[6-10] Place a towel for padding between the patient's head and the LSB as required to prevent hyperextension.[1]

Step 4

Officers 2 & 3 kneel on either side of the patient, and holds the LSB by gripping the handholds slightly lower than the patient's armpit. Officer 2 & 3's other hands should hold the LSB one handhold above the patient's shoulders to assist with supporting the LSB whilst lowering it to the ground. Due to the LSBs position, Manual In-Line Stabilisation is not possible whilst lowering the LSB to the ground, so extreme care must be taken during the lowering procedure as a Cervical Collar alone is insufficient to prevent cervical spine movement.[2-5]

Step 5

Officers 2 & 3 slowly the lower the LSB and patient backwards until they are on the ground.

Step 6

Officer 1 re-establishes Manual In-Line Stabilisation until the patient is properly immobilised to the LSB.[2-5] Finally, slide the patient up the LSB (30 cm at a time) until the patient's shoulders are correctly aligned with the shoulder markings on the LSB. This is achieved by Officers 2 & 3 place one hand under the patient's armpits (avoid pushing the patient's shoulders anteriorly as this moves the patient's spinal column), and their other hand is placed over the pelvis to slide the patient. To prevent the LSB from sliding with the patient, place one foot on the edge of the LSB.

BACKBOARDING THE SITTING PATIENT

Step 7

Finally immobilise the patient to the LSB for transport (pg 208 - 215).[11]

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REMOVAL FROM AN ARMCHAIR

The following method offers a safe lifting technique for removing a patient who due to a medical condition, is unable to remove themselves from an arm chair.

Training Requirements:	**2 x Staff** **1 x Patient** **1 x Armchair** **1 x Long Spine Board (LSB)** **1 x Blanket** **1 x Pillow**

Procedure

Step 1

Position the armchair so that there is adequate room for the armchair to be tilted backwards.

Step 2

Officer 1 tilts the patient forward, whilst Officers 2 slides the LSB down behind the patient's back.

Officer 2 slides a blanket between the patient and the LSB for improved comfort.

REMOVAL FROM AN ARMCHAIR

Step 3

Lean patient back onto the LSB. A pillow can be inserted behind the patient's head to improve LSB comfort during transport.

Step 4

Officers 1 & 2 each place their front hand on the front of the armchair and their rear hand on the back support of the armchair.

Officers 1 & 2 then tilt the armchair backwards until the rear of the chair is resting firmly on the ground.

Do not hold the LSB at any time during this step.

Step 5

Holding the patient under their arms and knees, carefully slide the patient onto the LSB until correctly positioned.

Secure the patient to the LSB for transport.

LOG ROLLING THE UNCONCIOUS PATIENT

This manoeuvre allows the rapid placement of a unconscious medical patient onto the Long Spine Board (LSB) in the lateral position with minimal effort by the Officer.

This technique is designed for the curved LSB only and will not work with flat LSBs.

Training Requirements:	**1 x Staff** **1 x Patient** **1 x Long Spine Board (LSB)** **2 x Towel**

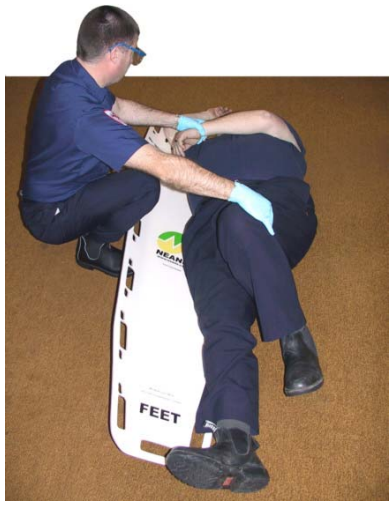
Procedure

Step 1

Officer 1 places the LSB at head of patient.

Step 2

Officer 1 carefully rolls the patient onto their back.

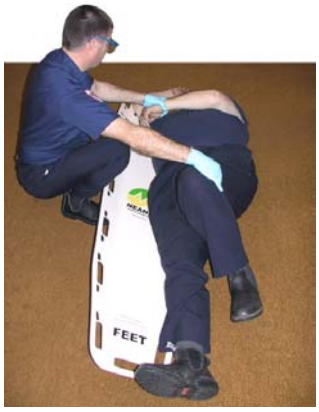


Step 3

Officer 1 places the patient's proximal arm out and bend at the elbow so that the patient's hand is resting under the patient's head. Place the patient's distal arm across their upper chest, and bend the patient's distal knee up.

Slide the LSB partially under the patient until the LSB's curved line is level with edge of patient's torso. If the LSB too far under the patient, the patient will come off the other side of the LSB . The LSB should now be sitting up at an angle.

LOGROLLING THE UNCONSCIOUS NON TRAUMA PATIENT



Step 4

Grasping the patient's upper hand and knee, roll the patient towards the LSB .

The curve of the LSB will greatly assist the patient rolling onto the LSB .

Step 5

The patient can now be secured to the LSB for transfer.

Padding using a towel will be required underneath the patient where ever the patient contacts the edge of the LSB to prevent pressure points.

PAT-SLIDE THE SITTING PATIENT

The Sitting Pat-Slide technique can be used to transfer patients from numerous positions such as bed to stretcher, stretcher to wheelchair and vice versa. The manoeuvre can also be used to transfer obese patients, who, due to medical conditions (eg respiratory distress) cannot be laid flat for using the hospital Pat-slide or poles.

Training Requirements:	**2 x Staff** **1 x Patient** **1 x Long Spine Board (LSB)** **1 x Stretcher** **1 x Trolley**

Procedure

Step 1

The Officers place their stretcher beside and parallel to the trolley with a gap of approximately 90 to 120 cm. The Officers stretcher is slightly higher than the trolley the patient will be moving onto, so that gravity will assist with the transfer.

Step 2

Officer 1 slides the LSB underneath the patient's bottom, and rests the other end of the LSB on the trolley.

PAT-SLIDING THE SITTING PATIENT

Step 3

Officer 1 crosses and grasps the patient's arms, then supports the patient from behind. Officer 2 holds the patient's ankles.

When ready, Officers 1 & 2 slide the patient down the LSB.

With gravity assisting, there should be no actual lifting of the patient during the slide.

Step 4

Once the patient is on the trolley, raise the trolley's head to support the patient in the sitting position.

Step 5

Finally remove the LSB from under the patient.

PAT-SLIDE THE LYING PATIENT

The following technique allows the Officers to transfer a patient in the lying position onto a Long Spine Board (LSB), with less movement or stress placed on the spinal column when compared to other manoeuvres currently practiced. It is used in a similar manner to the fibreglass Pat-Slide found in many hospitals for transferring patients from beds to stretchers.

Points To Remember:

The LSB has a number of advantages over the hospital Pat-Slide which include:

- *As the patient is placed on a rigid platform, the LSB rather than the patient is slid across onto the stretcher. As there is less movement of the patient during the transfer, there is reduced manipulation of the patient's injuries and a reduction in pain felt by the patient during the transfer.*
- *The patient can be kept on the LSB during transport, thus reducing the need to log roll the patient as often.*

Training Requirements:	**2 x Staff** **1 x Patient** **1 x Long Spine Board (LSB)** **1 x Blanket** **1 x Stretcher** **1 x Trolley**

Procedure

Step 1

Place both the stretcher and trolley beside and parallel to each other. Ensure both the stretcher and trolley are adjusted to the same height

PAT-SLIDING THE LYING PATIENT

Step 2

Both Officers slide the LSB's head end across from the stretcher to the trolley.

Step 3

Both Officers then slide the LSB's foot end across from the stretcher onto the trolley.

VEHICLE EXTRACTION TECHNIQUES

INTRODUCTION

The introduction of the Long Spine Board (LSB) in prehospital setting allows for vast improvements into the standard of spinal care, and greatly eases patient removal from motor vehicles.

In many cases, extraction of the patient onto a LSB was found to be eased if a patient was placed into a jacket style Cervical Extrication Device (CED). Not only will the CED provide extremely effective cervical and partial thoracic / lumbar spine immobilisation, it will also ease the extrication by "placing handles on the patient". If the patient does not meet the definition of an 'Actual Time Critical' patient; **OR** the patient is trapped & is classed as Actual Time Critical, but the CED will not delay on-scene time, then a CED should be applied where appropriate.

PRINCIPLES OF EXTRACTION

In determining the method of patient removal (egress) from a vehicle, the two basic principles should be applied:[1-4]

1. MAINTAIN SPINAL ALIGNMENT

- to minimise spinal cord injury and paralysis

2 MINIMAL BODY TWISTING

- to reduce further injuries and reduce fracture movement & pain

By adopting these two principles, all Officers at the scene of an motor vehicle crash (both RESCUE and AMBULANCE staff) are able to rapidly establish the method and direction of patient removal. This reduces confusion between organisations at the scene of how the patient is to be extracted, allowing organisations to quickly determine set-up areas, and assists Rescue personal in making rapid decisions into stabilisation and allows correct cutting techniques to be implemented. Scene delays due to poor scene co-ordination and unnecessary vehicle cuts have the potential to decrease patient survival.[2-3]

Principles of extraction are demonstrated in the following section.

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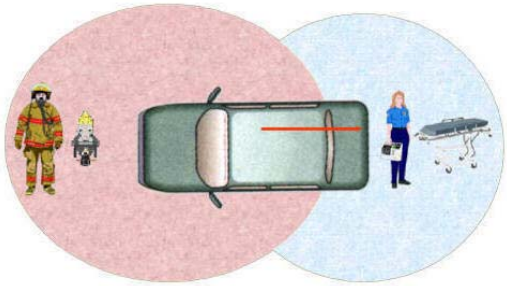
SCENE SETUP

Overcrowding and poor placement of equipment at the scene of an scene by Rescue and Ambulance Officers (causing scene cluttering & trip hazards requiring multiple movements of equipment) can result in delays in the extraction to the detriment of the patient.[1-2] By following the basic principles below, these problems can be reduced by limiting crossover work areas, as well as making a safer and more efficient working environment.

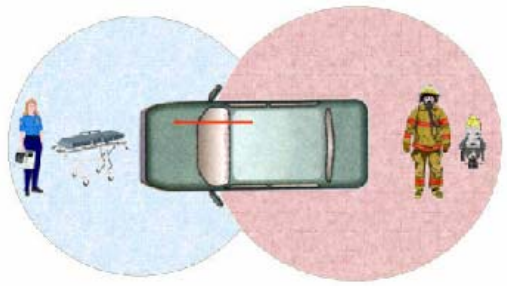
Basic principles of equipment placement is to position ambulance equipment and staff in the direction the patient will be extracted, whilst placing the rescue equipment staging area at the 180º opposing position.

Some basic examples include:



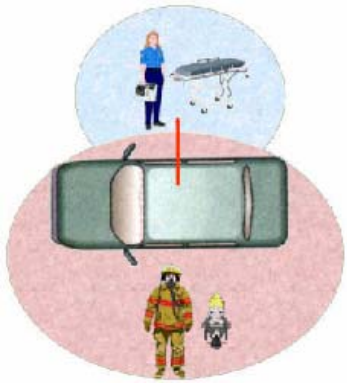
Rear Extraction

- Ambulance equipment & Officers set-up are placed at the rear of the vehicle.
- Rescue staging area & Officers are placed at the front of the vehicle.



Front Extraction

- Ambulance equipment & Officers set-up are placed at the front of the vehicle.
- Rescue staging area & Officers are placed at the rear of the vehicle.



Side Extraction

- Ambulance equipment & Officers set-up are placed at the side of the vehicle the patient will be extracted from.
- Rescue staging area & Officers are placed on the opposite side of the vehicle.

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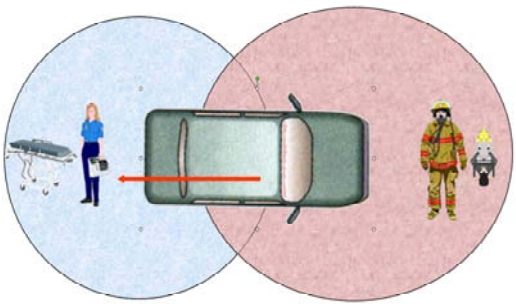
REAR WINDOW EXTRACTION
FRONT SEAT

The following technique has been found, through extensive trials, to be the preferred method for patient extraction when the patient is found sitting normally in the front seat of a vehicle. The advantages of this method are spinal alignment (to protect the spinal cord) is maintained, and body twisting (which can further aggravate fractures and other injuries) is minimised as compared to other techniques available.

Training Requirements:	**6 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Cervical Extrication Device (CED)** **1 x Long Spine Board (LSB)** **1 x Rope** **2 x Blanket** **1 x Stretchers** **Vehicle Cutting Equipment**

Scene Setup

With the patient in this scenario being extracted out through the rear window, the following general principles should be applied whenever practical:



- Ambulance equipment staging area should be setup at the rear of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the front of the vehicle on the 5 m outer circle.
- Fire protection with a live hose is again placed on the 5 m outer circle, but at 45º to the front of the vehicle so as not to interfere with the Rescue staging area.

REAR WINDOW EXTRICATION - FRONT SEAT

Step 1

Perform Manual In-Line Stabilisation of the patient's head (pg 55 - 60) and apply a Cervical Collar (pg 73 - 79).

Step 2

Apply a CED (pg 81 - 95) if the patient is not time-critical, or the patient is time critical but the application of the CED will not delay the extraction The CED will immobilise the cervical spine, as well as provide handles to ease the lifting and sliding of the patient.[1-7]

If the patient is time critical and the CED will delay extraction, consider application of the CED as a lifting device (application of the chest and groin straps only) which takes less than 2 minutes to apply, if the benefit of preventing gross twisting of the spine, and the prevention of back injury to the Officers undertaking the extraction is justified.

If a CED is not applied, manual in-line stabilisation needs to be maintained until the patient is properly immobilised onto a LSB (pg 208 - 217).[1-9]

Tie the patient's legs together as outward rotation of the legs will cause pelvic girdle movement and therefore movement of the spinal column.

Step 3a

Removal of the lower section of the steering wheel is an option that will create additional space for the removal of the driver, and prevents the common problem of feet getting caught during the extraction.

REAR WINDOW EXTRICATION - FRONT SEAT

Step 3b

To allow for the removal of a patient through a rear window, an opening needs to be made. Generally removal of, or the faster process of breaking the rear window will be adequate.

Step 3c

If the rear window removal provides insufficient space for the patient to be extracted through, spreading of the back window with the hydraulic spreaders, ram or high-lift jack will crush the rear seat down and push the roof up, making significant space for patient removal.

Step 3d

Alternatively a forward roof flap will provide additional space when access to the patient from the sides is limited.

Rear roof flaps should be avoided as they will block the exit for the patient.

The current practice of door removal, will in many cases, not provide any assistance in the extraction of the patient unless the legs are trapped, but will simply increase scene time and should be avoided if there is no clear benefit.[10-11]

Step 3e

If the patients legs are trapped under the dash, additional cutting including the door removal and a dash roll may be necessary to free the patient.

REAR WINDOW EXTRICATION - FRONT SEAT

Step 3f

If the seat back will not rotate downward, cutting the seat's back support will allow the seat back to lay fully down

Step 4

Place a blanket over the window edge and boot to allow the LSB to easily slide in and out of the vehicle. Failure to do this may result in severe LSB vibration during extraction.

Place the LSB on top of the blanket in readiness for insertion behind the patient once the patient's seat is rotated back.

The option of pre-strapping the LSB with each strap attached at one end will speed up and ease securing patient to the LSB once the patient has been extracted.

Step 5

Place a rope through the back upper handle of the CED. This will be used to pull the patient up the LSB.

Step 6

Keep the patient sitting upright and lay the seat back fully. Do not allow the patient to rotate downward with the seat as the seat winding downward will cause jerking to the patient.

Slide the LSB into the seat.

REAR WINDOW EXTRICATION - FRONT SEAT

Step 7

Slide the patient up the LSB in slow 30 cm movements using the rope, as well as Officers on each side of the patient to assist the slide, and to ensure the pelvis and legs stay aligned with the patient's torso.

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Step 8

Slide the patient up the LSB until the patient's shoulders are level with shoulder markings on the LSB.

Step 9

Raise the foot of the LSB to a horizontal position and slide the LSB out of the vehicle until it is sitting in a stable position on the boot of the vehicle.

Step 10

Now immobilise the patient to the LSB.[9]

If a CED has been applied correctly, it is considered that further head immobilisation will generally not be necessary as the CED is currently considered to have splinted the cervical spine adequately.[1-7] However body immobilisation for protection of the thoracic and lumbar spinal cord will still be necessary.[9]

REAR WINDOW EXTRICATION - FRONT SEAT

Step 11

The patient can now be safely carried away from the vehicle to the Ambulance stretcher.

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Impact of on-site care, prehospital time, and level of in hospital care on survival in severely injured patients.

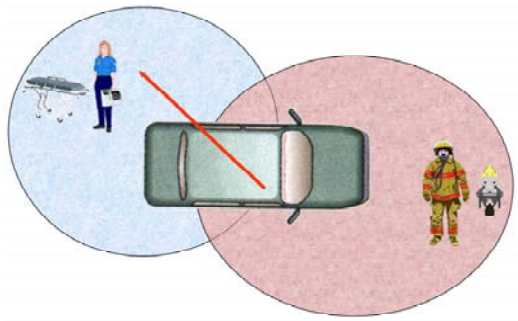
REAR SIDE WINDOW EXTRACTION
FRONT SEAT

The following technique offers an alternative extraction method when the patient is found sitting normally in the front seat of a vehicle, but cannot be extracted out the rear window of a vehicle.

Training Requirements:	**6 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Cervical Extrication Device (CED)** **1 x Long Spine Board (LSB)** **1 x Rope** **2 x Blankets** **1 x Stretcher** **Vehicle Cutting Equipment**

Scene Setup

With the patient in this scenario being extracted out a rear side window the following general principles should be applied whenever Practical:



- Ambulance equipment staging area should be setup at the rear of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the front of the vehicle on the 5 m outer circle.
- Fire protection with a live hose is again placed on the 5 m outer circle, but at 45º to the front of the vehicle so as not to interfere with the Rescue staging area.

REAR SIDE WINDOW EXTRACTION - FRONT SEAT

Step 1

Perform Manual In-Line Stabilisation of the patient's head (pg 55 - 60) and apply a Cervical Collar (pg 73 - 79).

Step 2

Apply a CED (pg 81 - 95) if the patient is not time critical, or the patient is time critical but the application of the CED will not delay the extraction. The CED will immobilise the cervical spine, as well as provide handles to ease the lifting and sliding of the patient.[1-7]

If the patient is time critical and the CED will delay extraction, consider application of the CED as a lifting device (application of the chest and groin straps only) which takes less than 2 minutes to apply, if the benefit of preventing gross twisting of the spine, and the prevention of back injury to the Officers undertaking the extraction is justified.

If a CED is not applied, manual in-line stabilisation needs to be maintained until the patient is properly immobilised onto a LSB (pg 208 - 217).[1-9]

Tie the patient's legs together as outward rotation of the legs will cause pelvic girdle movement and therefore movement of the spinal column.

Step 3

Place a rope through the back upper handle of the CED, which will be used to pull patient up the LSB.

REAR SIDE WINDOW EXTRACTION - FRONT SEAT

Step 4a

Removal of the lower section of the steering wheel is an option that will create additional space for the removal of the driver, and prevents the common problem of the feet getting caught during the extraction.

Step 4b

To allow for the removal of a patient through a rear side window, some additional space often needs to be made. Generally removal of the back 1/4 window will be required.

Step 5

Keep the patient sitting upright and rotate the back of the drivers seat fully down.

The front passenger seat should be slid forward and then the back of the seat rotated forward as much as possible to create additional space for LSB insertion.

REAR SIDE WINDOW EXTRACTION - FRONT SEAT

Step 6

Place a blanket over the rear passenger side window ledge to allow the LSB to easily slide in and out of the vehicle. Failure to do this may result in severe LSB vibration during extraction of the patient. Place the LSB on top of the blanket and slide the LSB through the closed door and into the seat.

The option of pre-strapping the LSB with each strap attached at one end will speed up and ease securing the patient to LSB once the patient has been extracted.

Step 7

Begin the slide out of the vehicle by positioning Officers at:

Officer 1 on the outside of the vehicle - drivers side, assists in the rotation of the patient's pelvis & legs during the extraction.

Officer 2 from behind supports the patient's head in the initial movement, and also assists in the rotation of the patient during the extraction.

Officer 3 from inside the vehicle passenger side assists in the rotation of the patient during the extraction.

Officers 4, 5 & 6 are positioned on the outside of the vehicle in the direction the patient will be extracted and will assist in the sliding of the patient out of the vehicle.

Step 8

Rotate the patient onto their side and onto the LSB.

It is essential the patient's pelvis and legs be rotated sideways as well during the side roll to prevent lateral bending of the spinal column.

REAR SIDE WINDOW EXTRACTION - FRONT SEAT

Step 9

Slowly slide the patient up the LSB in 30 cm movements using the rope to assist. Officers should be placed on either side of the patient if possible to assist the slide, and to ensure the patient's pelvis and legs stay aligned with their torso.

Step 10

Slide the patient up the LSB until the patient's shoulders are level with shoulder marking on the LSB.

Step 11

Raise the foot end of the LSB and slide the LSB out of the vehicle until it is sitting in a stable horizontal position on the window ledge of the vehicle.

REAR SIDE WINDOW EXTRACTION - FRONT SEAT

Step 12

Now immobilise the patient to the LSB (pg 208 - 217).[9]

If a CED has been applied correctly, it is considered that further head immobilisation will generally not be necessary as the CED is currently considered to have splinted the cervical spine adequately[1-7]. However body immobilisation for protection of the thoracic and lumbar spinal cord will still be necessary.

The patient can now be safely carried away from the vehicle to the Ambulance stretcher.

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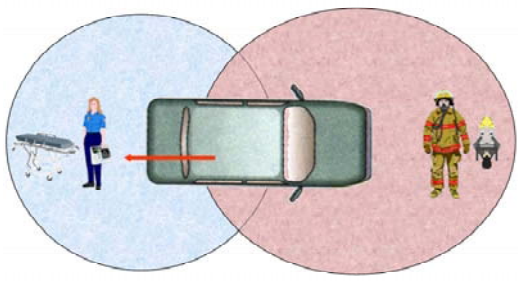
REAR WINDOW EXTRACTION
BACK SEAT

The following technique has been found through extensive trials, to be the best method for patient extraction when the patient is found sitting normally in the back seat of a vehicle. The advantages of this method are spinal alignment (to protect the spinal cord) is maintained, and body twisting (which can further aggravate fractures and other injuries) is minimised as compared to extraction through a side near door.

Training Requirements:	**5 x Staff** **1 x Patient** **1 x Cervical Collar** **2 x Triangular Bandages** **1 x Long Spine Board (LSB)** **1 x Rope** **1 x Blanket** **1 x Stretchers** **Vehicle Rescue Equipment**

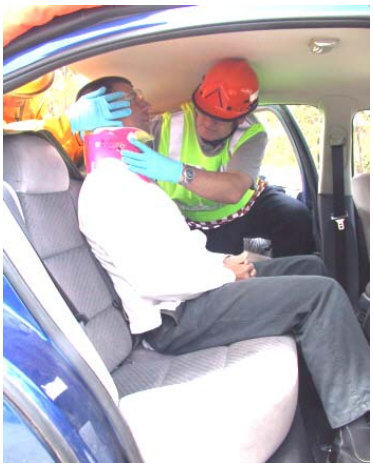
Scene Setup

With the patient in this scenario being extracted out through the rear window the following general principles should be applied whenever practical:



- Ambulance equipment staging area should be setup at the rear of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the front of the vehicle on the 5 m outer circle.
- Fire protection with a live hose is again placed on the 5 m outer circle, but at 45º to the front of the vehicle so as not to interfere with the Rescue staging area.

REAR WINDOW EXTRACTION - BACK SEAT



Step 1

Perform Manual In-Line Stabilisation of the patient's head (pg 55 - 60) and apply a Cervical Collar (pg 73 - 79).

Step 2

Apply groin straps on each leg of the patient using triangular bandages.

The groin straps must be placed in the gluteal fold to obtain proper stability for the extraction.

Step 3a

To allow for the removal of a patient through a rear window, an opening needs to be made. Generally removal of, or the faster process of breaking the rear window will be adequate.

Step 3b

Alternatively a forward roof flap will provide additional space when access to the patient from the sides is limited. A clear benefit needs to be demonstrated for time required to perform this manoeuvre.[2-3]

Rear roof flaps should be avoided as they will block the exit for the patient.

REAR WINDOW EXTRACTION - BACK SEAT

Step 4

Place a blanket over the window edge and boot to allow the LSB to easily slide in and out of the vehicle. Failure to do this may result in severe LSB vibration during extraction.

Lean the patient forward and insert the LSB behind the patients back.

The option of pre-strapping the LSB with each strap attached at one end only will speed up and ease securing the patient to LSB once the they have been extracted.

Step 5

Officers should be positioned in the following way:

Officer 1 stands at the back of the vehicle, places one foot on the boot of the vehicle and the other foot on the bumper of the vehicle. Officer 1 hands should hold the top handles of the LSB.

Officers 2 & 3 are positioned either side of the patient, kneeling on the boot of the vehicle, and with the arms closest to the LSB holding the groin straps. Officers 2 & 3's outer arms cross over and hold the LSB, locking their inner arm to the LSB so that during the extraction, the patient's position is maintained on the LSB.

Officers 4 & 5 are positioned inside the vehicle on either side of the patient. Officers 4 & 5 place one hand under the patient's knees to control the knees during the LSBs backward rotation to ensure the patients knees remain in the bent position. Officers 4 & 5 each place their other hand on the patient's ankles to prevent the patient's feet getting caught under the front seats.

REAR WINDOW EXTRACTION - BACK SEAT

Step 6

Begin the slide out of the vehicle by:

Officer 1 pushes himself off the vehicle's boot and whilst doing this, lifts the LSB 30 cm upwards (to allow the patient's feet to clear the front seat) and then pivots the head of the LSB down until the LSB is horizontal and resting on the boot of the vehicle.

Officers 2 & 3 ensure they continue locking their arms to the LSB during the LSB's movement so the patient does not slip down the LSB.

Officers 4 & 5 ensure the patient's knees remain in the bent position during the manoeuvre so as no pressure is placed on the spine. Once the LSB is in the horizontal position, the patient's knees should almost be touching the roof.

Step 7

Slowly slide the patient up the LSB in 30 cm movements with Officers on each side of the patient to assist the slide, and to ensure the pelvis and legs stay aligned with the torso. Officers 4 & 5 slowly straighten the legs as the patient is slid up the LSB.

REAR WINDOW EXTRACTION - BACK SEAT

Step 8

Now immobilise the patient to the LSB for transport (pg 208 - 217).[1]

Step 9

The patient can now be safely carried away from the vehicle to the Ambulance stretcher.

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Sci Am 1983;249:28.
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J Trauma 1993;34:252—61.
Impact of on-site care, prehospital time, and level of in hospital care on survival in severely injured patients.

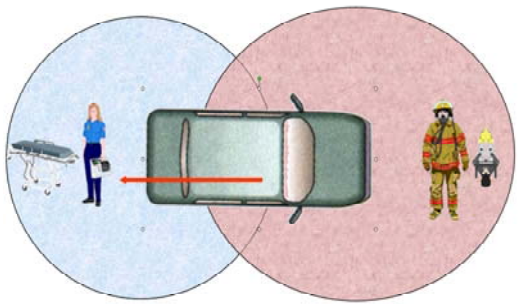
VERTICAL LIFT FROM A SEAT

The following technique is an option when the doors are jammed and will be difficult to open, the seat won't recline backwards (such as in a utility vehicle), and roof removal provides the easiest egress for the patient. It is adaptable to both front and rear seat patients. This technique is however the most difficult of all the extraction techniques taught in this manual, and is easier to achieve if the patient is placed in a jacket-style Cervical Extrication Device (CED) with handles. The advantages of this method are spinal alignment (to protect the spinal cord) is maintained, and body twisting (which can further aggravate fractures and other injuries) is minimised as compared to a side door extraction.

Training Requirements:	**4 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Cervical Extrication Device (CED)** **1 x Long Spine Board (LSB)** **1 x Blanket** **1 x Stretcher** **Vehicle Cutting Equipment**

Scene Setup

With the patient in this scenario being extracted out the rear of the vehicle, the following general principles should be applied whenever practical:



- Ambulance equipment staging area should be setup at the rear of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the front of the vehicle on the 5 m outer circle.
- Fire protection with a live hose is again placed on the 5 m outer circle, but at 45º to the front of the vehicle so as not to interfere with the Rescue staging area.

VERTICAL LIFT FROM A SEAT

Step 1

Perform Manual In-Line Stabilisation of the patient's head (pg 55 - 60) and apply a Cervical Collar (pg 73 - 79).

Step 2

Apply a CED if the patient is not time-critical, or the patient is time critical but the application of the CED will not delay the extraction (pg 81 - 95). The CED will immobilise the cervical spine, as well as provide handles to ease the lifting and sliding of the patient.[1-7]

If the patient is time critical and the CED will delay extraction, consider application of the CED as a lifting device (application of the chest and groin straps only) which takes less than 2 minutes to apply, if the benefit of preventing gross twisting of the spine, and the prevention of back injury to the Officers undertaking the extraction is justified.

If a CED is not applied, Manual In-Line Stabilisation of the patient's head needs to be maintained until the patient is properly immobilised onto a LSB (pg 208 - 217).

Step 3a

Removal of the lower section of the steering wheel is an option that will create additional space for the removal of the driver and prevents the common problem of their feet getting caught during the vertical lift.

VERTICAL LIFT FROM A SEAT

Step 3b

If access to the patient's lower legs is difficult, side door removal can be undertaken.

Door removal however is not essential for the manoeuvre to be successful. Therefore Officers must consider time vs. benefit.[10-11]

Step 3c

Folding the roof forward, or the less preferred option of complete roof removal will be required for the extraction of the patient from the vehicle.

Cutting of the front window for complete roof removal (required in new vehicles) creates significant amounts of glass dust and sharp hazards to the patient and Officers.

Step 4

Officers lean the patient slightly forward and slide the LSB into the seat from behind.

Step 5

Once the LSB is inserted, lean the patient back onto the LSB.

VERTICAL LIFT FROM A SEAT

Step 6

Begin the slide out of the vehicle on a LSB by positioning Officers at:

Officers 1 & 2 at the patient's head end hold the top half of the LSB with one hand, and hold the side handles of the CED with their other hand.

Officer 3 & 4 at the patient's pelvic end grab the bottom edge of the CED with one hand, and support under the patient's knees with their other hand.

Step 7

The patient is slid up the LSB in one quick action.

When the patient is 3/4 of the way up the LSB, the LSB is rotated backwards to a horizontal position.

Continue sliding the patient up the LSB 30 cm movements until the patient's shoulders are level with shoulder markings on the LSB.

Step 8

Now immobilise the patient to the LSB (pg 208 - 217).[9] If a CED has been applied correctly, it is considered that further head immobilisation will generally not be necessary as the CED is currently considered to have splinted the cervical spine adequately.[1-7] However body immobilisation for protection of the thoracic and lumbar spinal cord will still be necessary.

VERTICAL LIFT FROM A SEAT

Step 9

The patient can now be safely carried away from the vehicle to the Ambulance stretcher.

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11. Sampalis JS,
J Trauma 1993;34:252—61.
Impact of on-site care, prehospital time, and level of in hospital care on survival in severely injured patients.

OPPOSITE WINDOW EXTRACTION FROM A SEAT

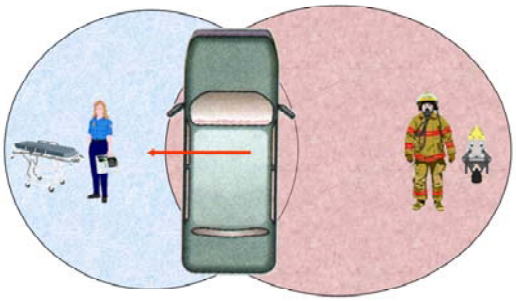
The following technique offers an alternative for when the patient is found sitting normally in the front or back seat of a vehicle, but the patient cannot be extracted out the rear window.

The procedure is also excellent as a rapid extraction technique when no cutting tools are available, and a rear window extraction is not an option (such as in a utility vehicle).

Training Requirements:	**6 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Cervical Extrication Device (CED)** **1 x Long Spine Board (LSB)** **1 x Rope** **2 x Blankets** **1 x Stretcher** **Vehicle Cutting Equipment**

Scene Setup

With the patient in this scenario being extracted out the side window, the following general principles should be applied whenever feasible:



- Ambulance equipment staging area should be setup at the extraction side of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the side opposite to the extraction of the vehicle on the 5 m outer circle..
- Fire protection with a live hose is again placed on the 5 m outer circle, but at the front of the vehicle so as not to interfere with the Ambulance or Rescue staging area.

OPPOSITE WINDOW EXTRACTION FROM A SEAT

Step 1

Perform Manual In-Line Stabilisation of the patient's head (pg 55 - 60) and apply a Cervical Collar (pg 73 - 79).

Step 2

Apply a CED if the patient is not time-critical, or the patient is time critical but the application of the CED will not delay the extraction (pg 81 - 95). The CED will immobilise the cervical spine, as well as provide handles to ease the lifting and sliding of the patient.[1-7]

If the patient is time critical and the CED will delay extraction, consider application of the CED as a lifting device (application of the chest and groin straps only) which takes less than 2 minutes to apply, if the benefit of preventing gross twisting of the spine, and the prevention of back injury to the Officers undertaking the extraction is justified.

If a CED is not applied, manual in-line stabilisation of the patient's head needs to be maintained until the patient is properly immobilised onto a LSB.[1-9] Tie the patient's legs together as outward rotation of the legs will cause pelvic girdle movement and therefore movement of the spinal column.

Step 3a

If Rescue is available, removal of the steering wheel will create additional space for the extraction of the driver, and prevents the patient's legs & feet getting caught during the roll out.

OPPOSITE WINDOW EXTRACTION FROM A SEAT

Step 3b

To allow for the removal of a patient through a side window, additional space can be made by performing a vertical spread in the window, although this is often not required.

Opening the door, whilst creating additional space, will however cause the angle of the LSB to be lowered and increase lateral bending of the spine.

Step 3c

A forward roof flap or full roof removal will also provide additional head space, when access to the patient from the sides is limited, or the dash has been crushed in on the patient.

Again if there is no clear benefit, a forward roof flap or full roof removal should be avoided due to added scene time.[10-11]

Step 4

Place a blanket over the side window ledge to allow the LSB to easily slide in and out of the vehicle. Failure to do this may result in severe LSB vibration during extraction of the patient.

Place the LSB on top of the blanket and slide the LSB through the window opening and onto the seat the patient is sitting on.

The option of pre-strapping the LSB with each strap attached at one end only will speed up and ease securing the patient to LSB once the patient has been extracted.

OPPOSITE WINDOW EXTRACTION FROM A SEAT

Step 5

Place a rope through the back upper handle of the CED, which will be used to pull patient up the LSB.

Step 6

Begin the slide out of the vehicle on the LSB by positioning Officers at:

Officer 1 on the outside of the vehicle - drivers side, assists in the rotation of the patient's pelvis & legs during the extraction.

Officer 2 from behind supports the patient's head in the initial movement, and also assists in the rotation of the patient during the extraction.

Officers 3, 4 & 5 are positioned on the outside of the vehicle in the direction the patient will be extracted and will assist in sliding the patient out of the vehicle.

Step 7

Rotate the patient onto their side onto the LSB.

It is essential the patient's pelvis and legs be rotated sideways as well during the side roll to prevent lateral bending of the patient's spinal column.

Step 8

Slide the patient up the Board in 30 cm movements using the rope. Officer 1 should remain at the patient's feet if possible to assist the slide, and to ensure the patient's pelvis and legs stay aligned with the torso.

OPPOSITE WINDOW EXTRACTION FROM A SEAT

Step 9

As the patient is being slid up the LSB, slowly rotate the patient onto their back.

Step 10

The patient is slid up the LSB until the patient's shoulders are level with the shoulder markings on LSB in preparation for immobilisation.

Raise the foot end of the LSB until the LSB is horizontal.

Step 11

Now immobilise the patient to the LSB (pg 208 - 217).[9]

If a CED has been applied correctly, it is considered that further head immobilisation will generally not be necessary as the CED is currently considered to have splinted the cervical spine adequately.[1-7] However body immobilisation for protection of the thoracic and lumbar spinal cord will still be necessary.

Step 12

The patient can now be safely carried away from the vehicle to the Ambulance stretcher.

OPPOSITE WINDOW EXTRACTION FROM A SEAT

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1. Cline
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Impact of on-site care, prehospital time, and level of in hospital care on survival in severely injured patients.

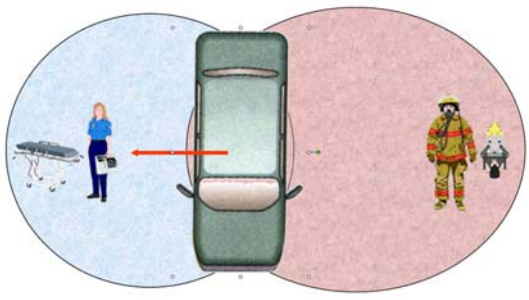
SIDE EXTRACTION
LEANING ON A DOOR

The following technique offers an option when the patient is sitting with their back leaning against a door. The advantages of this method are spinal alignment (to protect the spinal cord) is maintained, and body twisting (which can further aggravate fractures and other injuries) is minimised.

Training Requirements:	**4 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Long Spine Board (LSB)** **1 x Stretcher** **Vehicle Cutting Equipment**

Scene Setup

With the patient in this scenario being extracted out a side door, the following general principles should be applied whenever feasible:



- Ambulance equipment staging area should be setup at the extraction side of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the side opposite to the extraction of the vehicle on the 5 m outer circle.
- Fire protection with a live hose is again placed on the 5 m outer circle at the front of the vehicle so as not to interfere with the Ambulance or Rescue staging area.

SIDE EXTRACTION - LEANING ON A DOOR

Step 1

Perform Manual In-Line Stabilisation of the patient's head (pg 55 - 60) and apply a Cervical Collar (pg 73 - 79).

Step 2a

Lean patient forward off the door and fully open beyond the normal hinge position if possible. Place the LSB in behind the patient and rest the LSB on the seat. Lean the patient back onto the LSB.

Push the door forward out of the way for improved access for the extraction.

Step 2b

If the door is jammed closed, lean patient forward off the door, cut the doors window frame, slide the Board through the open window and rest the LSB on the seat.

Lean the patient back onto LSB, but ensure the LSB is not resting on the door.

Forcefully open the door.

Consider undertaking full door removal only if there is a time vs benefit of the additional space for the extraction of the patient.[2-3]

SIDE EXTRACTION - LEANING ON A DOOR

Step 3

Begin the slide out of the vehicle by positioning Officers by:

Officer 1 remains on the inside of the vehicle and will assist in the movement of the patient's legs during the extraction.

Officer 2 remains on the outside of the vehicle and will insert the LSB, and will assist Officers 3 & 4 in the extraction of the patient.

Officer s3 & 4 place themselves on the outside of the vehicle, assisting in the slide and extraction of the patient onto the LSB.

Step 4

Rotate the LSB downwards into a horizontal position.

Once the LSB is in the horizontal position, slide the patient along the LSB in 30 cm movements until the patient's shoulders are level with shoulder markings on the LSB.

Step 5

Now immobilise the patient to the LSB (pg 208 - 217).[1]

The patient can now be safely carried away from the vehicle to the Ambulance stretcher.

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1. Victorian Ministerial Task Force on Trauma
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SIDE DOOR EXTRACTION FROM A SEAT

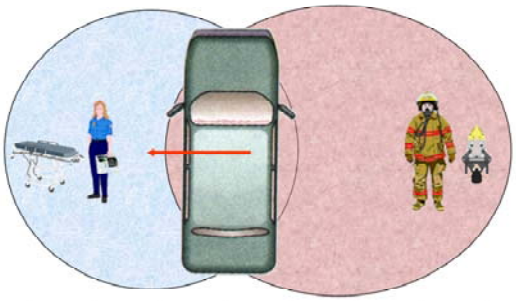
The following technique should be used as a last resort for when the patient is found sitting normally in the front or back seats of a vehicle, but the patient cannot be extracted out the rear window.

This method causes significant spinal and body twisting (which can further aggravate spinal cord function, fractures and other injuries), and is an increased OH&S risk to Officers undertaking the extraction as compared to other techniques offered.

Training Requirements:	**6 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Cervical Extrication Device (CED)** **1 x Long Spine Board (LSB)** **1 x Stretcher** **Vehicle Cutting Equipment**

Scene Setup

With the patient in this scenario being extracted out the side door, the following general principles should be applied whenever feasible:



- Ambulance equipment staging area should be setup at the extraction side of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the side opposite to the extraction of the vehicle on the 5 m outer circle.
- Fire protection with a live hose is again placed on the 5 m outer circle, but at the front of the vehicle so as not to interfere with the Ambulance or Rescue staging area.

SIDE DOOR EXTRACTION FROM A SEAT

Step 1

Perform Manual In-Line Stabilisation of the patient's head (pg 55 - 60) and apply a Cervical Collar (pg 73 - 79).

Step 2

Apply a CED (pg 81 - 95) if the patient is not time critical, or the patient is time critical but the application of the CED will not delay the extraction The CED will immobilise the cervical spine, as well as provide handles to ease the lifting and sliding of the patient.[1-7]

If the patient is time critical and the CED will delay extraction, consider application of the CED as a lifting device (application of the chest and groin straps only) which takes less than 2 minutes to apply, if the benefit of preventing gross twisting of the spine, and the prevention of back injury to the Officers undertaking the extraction is justified.

If a CED is not applied, manual in-line stabilisation of the patient's head needs to be maintained until the patient is properly immobilised onto a LSB.[1-9]

Tie the patient's legs together as outward rotation of the legs will cause pelvic girdle movement and therefore movement of the spinal column.

Step 3a

If Rescue is available, removal of the steering wheel will create additional space for the extraction of the driver, and prevents legs & feet getting caught during the slide out.

SIDE DOOR EXTRACTION FROM A SEAT

Step 3b

To allow for the removal of a patient through a side door, an opening needs to be made.

Push the door open fully to provide an adequate opening.

Step 3c

An alternative to the above is full door removal, but as this takes additional time, a clear benefit is needed to justify this added scene time (such as the requirement for a dash roll due to the legs being trapped under the dashboard).[10-11]

Step 3d

The height of a patient sitting in a seat, is often higher than the roof line of the door. This requires the patient to be quashed down or tilted sideways to get out of the vehicle for this procedure. If the seat cannot be lowered adequately to clear the patients head, consider flapping the side of the roof.

Step 3e

A forward roof flap or full roof removal will also provide additional head space, when access to the patient from the sides is limited, or the dash has been crushed in on the patient.

Again if there is no clear benefit, a forward roof flap or full roof removal should be avoided due to added scene time.[10-11]

SIDE DOOR EXTRACTION FROM A SEAT

Step 4

Position Officers at:

Officer 1 is placed behind the patient to assist in the rotation of the patient during the extraction.

Officer 2 is placed on the inside of the vehicle and grasps the handle of the CED to lift the patient for LSB insertion under the patient.

Officer 3 is placed on the outside of the vehicle and grasps the handle of the CED to lift the patient for LSB insertion under the patient.

Officer 4 is placed on the outside of the vehicle and inserts the LSB under the patient's bottom when Officers 2 & 3 lift the patient.

Step 5

Begin the slide out of the vehicle by keeping the patient in a sitting position and:

Officer 1 from behind supports the patient's head in the initial movement.

Officer 2 inside the vehicle assists in the rotation of the patient's legs the extraction.

Officer 3 grasps the inner side handle of the CED as soon as it can be reached.

Officer 4 holds the outer side handle of the CED at the beginning of the slide and will assist in the rotation & control of the torso of the patient during the extraction.

Officer 5 & 6 support the end of the LSB.

The patient is slid slowly in 30 cm movements along the LSB and slowly rotated ensuring the patient's pelvis and legs are kept in alignment to the torso.

SIDE DOOR EXTRACTION FROM A SEAT

Step 6

Once the patient is 1/2 way along the LSB, the patient is laid down onto the LSB.

Step 7

The patient is slid up the LSB until the patient's shoulders are level with the shoulder markings on LSB in preparation for immobilisation.

Step 8

Now immobilise the patient to the LSB (pg 208 - 209).[9]

If a CED has been applied correctly, it is considered that further head immobilisation will generally not be necessary as the CED is currently considered to have splinted the cervical spine adequately.[1-7] However body immobilisation for protection of the thoracic and lumbar spinal cord will still be necessary.[9]

The patient can now be safely carried away from the vehicle to the Ambulance stretcher.

SIDE DOOR EXTRACTION FROM A SEAT

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1. Cline
Journal Of Emergency Medicine 1990
Comparison Of Rigid Immobilisation Collars

2. Cline
Journal Of Trauma 25:649-653 1985
A Comparison Of Methods Of C-Spine Immobilisation Used In Patient Extrication And Transport

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Annals Of Emergency Medicine October 1987
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11. Sampalis JS,
J Trauma 1993;34:252—61.
Impact of on-site care, prehospital time, and level of in hospital care on survival in severely injured patients.

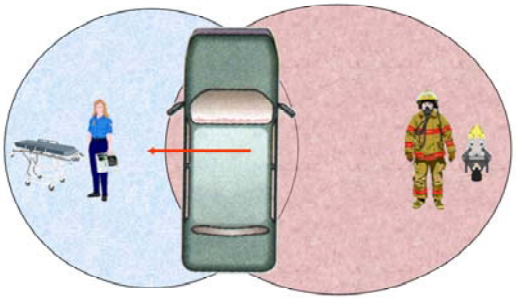
VEHICLE ON SIDE EXTRACTION

The following technique offers one of numerous options for a vehicle on it's side.

Training Requirements:	**5 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Blanket** **1 x Long Spine Board (LSB)** **1 x Stretcher** **Vehicle Cutting Equipment**

Scene Setup

With the patient in this scenario being extracted out the roof, the following general principles should be applied whenever practical:



- Ambulance equipment staging area should be setup at the extraction side of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the side opposite to the extraction of the vehicle on the 5 m outer circle..
- Fire protection with a live hose is again placed on the 5 m outer circle, but at the front of the vehicle so as not to interfere with the Ambulance or Rescue staging area.

VEHICLE ON SIDE EXTRACTION

Step 1

Once the vehicle has been stabilised, Officers can enter the vehicle and perform Manual In-Line Stabilisation of the patient's head (pg 55 - 60) and apply a Cervical Collar (pg 73 - 79).

The use of a jacket style Cervical Extrication Device (CED) is very limited in these cases unless the patient is found in an upright sitting position.

Step 2

To allow for the removal of a patient, a number of options are available.

Complete roof removal offers the greatest access to the patient and the safest work area for Officers.

Roof removal is undertaken by:

1. Cutting the upper side A, B & C pillars, removing or cutting the windscreen, making two relief cuts in the roof and then folding the roof down.

2. A can opener is then used to remove the roof at the crease, with the remaining sharp edges covered with sharps protection.

This roof removal technique has the advantage of the side of the vehicle in which the patient is lying on (including door and window) remains intact.

Step 3

Place the LSB on top of the sharps protection. The addition of a blanket over the sharps protection will further allow the LSB to slide easily in and out of the vehicle. Failure to do this may result in severe LSB vibration during extraction.

Step 4

The patient will usually be found on their back or side, however LSB insertion is similar in either situation. To insert the LSB under the patient, the patient will need to be lifted using a modified Straddle Lift - Side technique (page 115):

Officer 1 places the LSB at the patient's head.

Officer 2 positions at the patient's head and stabilises the patient's head for the LSB's insertion.

Officers 3 & 4 are positioned on either side of the patient at the patient's torso, placing their hands under the patients shoulders and pelvis.

Officer 5 positions at the patients feet and will assist the legs onto the LSB.

When ready, Officers 2, 3 & 4 raise the patient 3-5 cm whilst Officer 1 slides the LSB under the patient.

VEHICLE ON SIDE EXTRACTION

Step 5

Officers begin the slide out of the vehicle onto a LSB by:

Officer 1 continues to support the LSB.

Officer 2 continues to stabilise the patient's head during the slide out of the vehicle onto the LSB.

Officer 3 & 4 positioned on the either side of the LSB assist in the sliding of the patient out of the vehicle by grasping the patient's clothing at the shoulders and waist.

Officer 5 positioned at the patients feet assist the patient's legs onto the LSB.

The patient is slid up the LSB in 30 cm movements until the patient's shoulders are level with the shoulder markings on LSB in preparation for immobilisation.

Step 6

If the patient was extracted on their back, immobilise the patient to the LSB (pg 208 - 217).[1]

However if the patient was extracted on their side (as depicted here), carry the patient to a safe place and log roll the patient onto their back (page 110), then immobilise to the LSB (pg 208 - 217).[1]

The patient can now be safely carried to the Ambulance stretcher.

Bibliography

1. Victorian Ministerial Task Force on Trauma
Review Of Trauma And Emergency Services Report 1999

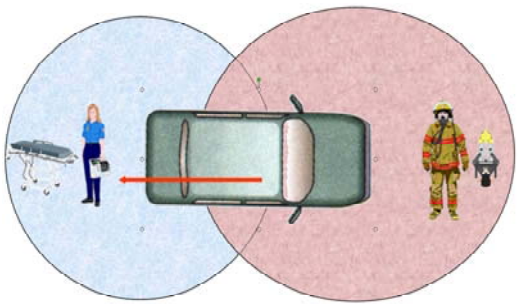
VEHICLE OF ROOF
REAR EXTRACTION

The following technique offers an option for a vehicle on it's roof when the patient has been released from their seatbelt and fallen onto the roof of the vehicle with their head and torso pointing towards the rear of the vehicle. The advantages of this method are spinal alignment (to protect the spinal cord) is maintained, and body twisting (which can further aggravate fractures and other injuries) is minimised as compared to other techniques available.

Training Requirements:	**4 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Blanket** **1 x Long Spine Board (LSB)** **1 x Stretcher** **Vehicle Cutting Equipment**

Scene Setup

With the patient in this scenario being extracted out the rear of the vehicle, the following general principles should be applied whenever feasible:



- Ambulance equipment staging area should be setup at the rear of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the front of the vehicle on the 5 m outer circle.
- Fire protection with a live hose is again placed on the 5 m outer circle, but at a 45º angle to the front of the vehicle so as not to interfere with the Ambulance or Rescue staging area.

VEHICLE ON ROOF - REAR EXTRACTION

Step 1

Once the vehicle has been stabilised, Officers can enter the vehicle a perform Manual In-Line Stabilisation of the patient's head (pg 55 - 60).

If the patient is in the prone position (lying on their front) as depicted here, a Cervical Collar cannot be applied.

The use of a jacket style Cervical Extrication Device (CED) is very limited in these cases unless the patient is found in an upright sitting position in the vehicle.

Step 2a

To allow for the removal of a patient through a rear window, an opening needs to be made. Generally removal of, or the faster process of breaking the rear window will be adequate.

Step 2a

To allow for access to the patient, the doors of the vehicle will need to be opened.

In rare cases full side removal will be required for adequate access to the patient, but a clear benefit is needed to justify the extra time.[2-3]

Please Note: In this scenario, a full side removal has been undertaken to allow improved viewing of the extraction technique.

Step 3

Place a blanket over the broken glass to allow the LSB to easily slide in and out of the vehicle. Failure to do this may result in severe LSB vibration during extraction.

The patient will usually be found on their stomach or side, however LSB insertion is similar in either situation. To insert the LSB under the patient, the patient will need to be lifted using a modified Straddle Lift - Side technique (page 115):

Officer 1 places the LSB at the patient's head.

Officer 2 positions at the patients head and stabilises the patient's head for the LSB's insertion.

Officers 3 & 4 are positioned on either side of the patient at the patient's torso, each placing one hand under the patient's shoulders and the other hand under the pelvis.

When ready, Officers 2, 3 & 4 raise the patient 3-5 cm whilst Officer 1 slides the Board under the patient until it stops (usually about the patients waist level).

VEHICLE ON ROOF - REAR EXTRACTION

Step 4

Begin the slide out of the vehicle by:

Officer 1 continues to support the LSB.

Officer 2 continues to stabilise the patent's head during the slide out of the vehicle onto the LSB.

Officers 3 & 4 positioned on the either side of the Board assist in the sliding of the patient onto the Board by grasping clothes at the shoulders and waist.

The patient is slid up the LSB in 30 cm movements until the patient's shoulders are level with the shoulder markings on LSB in preparation for immobilisation.

Once the patient is correctly positioned of the LSB, slide the LSB out of the vehicle and place it on the ground.

Step 5

If the patient was extracted supine (on their back), immobilise the patient to the LSB (pg 208 - 217).[1]

However if the patient was extracted on their side or stomach (as depicted here), carry the patient to a safe place and log roll the patient using the log roll 5 person prone 180º technique (page 111) to get the patient supine, then immobilise (pg 208 - 217).[1]

The patient can now be safely carried to the Ambulance stretcher.

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1. Victorian Ministerial Task Force on Trauma
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2. Trunkey
Sci Am 1983;249:28.
Trauma.

3. Sampalis JS,
J Trauma 1993;34:252—61.
Impact of on-site care, prehospital time, and level of in hospital care on survival in severely injured patients.

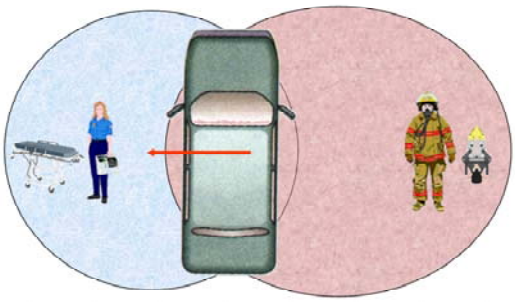
VEHICLE ON ROOF SIDE EXTRACTION

The following technique offers an option for a vehicle on it's roof when the patient has been released from their seatbelt and fallen onto the roof of the vehicle with their head and torso pointing towards the side of the vehicle. The advantages of this method are spinal alignment is maintained, and body twisting (which can further aggravate fractures and other injuries) is minimised as compared to other techniques available.

Training Requirements:	**4 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Blanket** **1 x Long Spine Board (LSB)** **1 x Stretcher** **Vehicle Cutting Equipment**

Scene Setup

With the patient in this scenario being extracted out the side of the vehicle, the following general principles should be applied whenever feasible:



- Ambulance equipment staging area should be setup at the extraction side of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the side opposite to the extraction of the vehicle on the 5 m outer circle..
- Fire protection with a live hose is again placed on the 5 m outer circle, but at the front of the vehicle so as not to interfere with the Ambulance or Rescue staging area.

VEHICLE ON ROOF - SIDE EXTRACTION

Step 1

Once the vehicle has been stabilised, Officers can enter the vehicle and perform Manual In-Line Stabilisation of the head (pg 55 - 60).

If the patient is in the prone position (lying on their front) as depicted here, a Cervical Collar cannot be applied.

The use of a jacket style Cervical Extrication Device (CED) is very limited in these cases unless the patient is found in an upright sitting position in the vehicle.

Step 2a

To allow for the removal of a patient, the doors of the vehicle will need to be opened.

Step 2b

Full side removal will provide excellent access to the patient and ease the extraction.

Please Note: In this scenario, a full side removal has been undertaken to allow improved viewing of the extraction technique.

Step 2c

Rotating the seat's back support fully rearwards will also create additional space for the extraction.

VEHICLE ON ROOF - SIDE EXTRACTION

Step 3

Place a blanket over the roof ledge to allow the LSB to easily slide in and out of the vehicle. Failure to do this may result in severe LSB vibration during extraction.

The patient will usually be found on their stomach or side, however LSB insertion is similar in either situation. To insert the LSB under the patient, the patient will need to be lifted using a modified Straddle Lift Side technique (page 115):

Officers 1 & 2 are positioned on either side of the patient at the patient's torso, each placing one hand under the patient's shoulders and the other hand under the patient's pelvis.

Officer 3 positioned at the patient's head continues stabilising the patient's head for the LSB insertion.

Officer 4 places the LSB at the patient's head.

When ready, Officers 1, 2 & 3 raise the patient 3-5 cm whilst Officer 4 slides the LSB under the patient until it stops (usually about the patients waist level).

VEHICLE ON ROOF - SIDE EXTRACTION

Step 4

Officers begin to slide the patient out of the vehicle on the LSB by:

Officer 4 continues to support the LSB.

Officer 3 continues to stabilise the patient's head during the patient's slide out of the vehicle onto the LSB.

Officers 1 & 2 positioned on the either side of the LSB assist in the sliding of the patient onto the LSB by grasping the patient's clothes at the shoulders and waist.

The patient is slid up the LSB in 30 cm movements until the patients shoulders are level with the shoulder markings on LSB in preparation for immobilisation.

Once the patient is correctly positioned on the LSB, slide the LSB out of the vehicle and place it on the ground.

Step 5

If the patient was extracted supine (on their back), immobilise the patient to the LSB (pg 208 - 217).[1]

However if the patient was extracted on their side or stomach (as depicted here), carry the patient to a safe place and log roll the patient using the log roll 5 person prone 180º technique (page 111) to get the patient supine, then immobilise (pg 208 - 217).[1]

The patient can now be safely carried to the Ambulance stretcher.

Bibliography

1. Victorian Ministerial Task Force on Trauma
Review Of Trauma And Emergency Services Report 1999

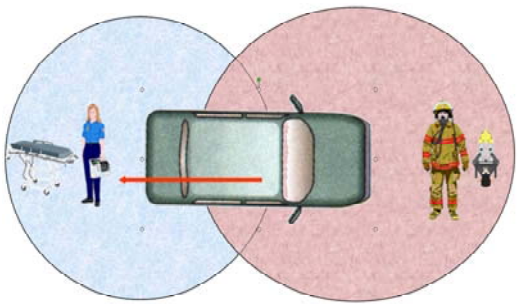
VEHICLE OF ROOF EXTRACTION FROM A SEATBELT

The following technique offers an option for a vehicle on it's roof with the patient still strapped in their seatbelt. The advantages of this method are the removal from the seatbelt can be achieve rapidly compared to other methods, spinal alignment is maintained, and body twisting (which can further aggravate fractures and other injuries) is minimised as compared to other techniques available.

Training Requirements:	**5 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Blanket** **1 x Cervical Extrication Device (CED)** **1 x Long Spine Board (LSB)** **1 x Stretchers**

Scene Setup

With the patient in this scenario being extracted out the rear of the vehicle, the following general principles should be applied whenever feasible:



- Ambulance equipment staging area should be setup at the rear of the vehicle on the 5 m outer circle.
- Rescue equipment staging area should be setup at the front of the vehicle on the 5 m outer circle.
- Fire protection with a live hose is again placed on the 5 m outer circle, but at 45º angle to the front of the vehicle so as not to interfere with the Ambulance or Rescue staging area.

VEHICLE ON ROOF - EXTRACTION FROM A SEATBELT

Step 1

Once the vehicle has been stabilised, Officers can enter the vehicle and perform Manual In-Line Stabilisation of the patient's head (pg 55 - 60).

Step 2a

To allow for the removal of a patient through a rear window, an opening needs to be made. Generally removal of, or the faster process of breaking the rear window will be adequate.

Step 2b

To allow for access to the patient, the doors of the vehicle will need to be opened.

In rare cases full side removal will be required for adequate access to the patient, but a clear benefit is needed to justify the extra time.[2]

Please Note: In this scenario, a full side removal has been undertaken to allow improved viewing of the extraction technique.

VEHICLE ON ROOF - EXTRACTION FROM A SEATBELT

Step 3

Officers are positioned at the following places:

Officers 1 & 2 are positioned on either side of the patient's torso - Officer 1 outside the vehicle and Officer 2 inside the vehicle.

Officer 3 & 4 are positioned on either side of the patient's pelvis - Officer 3 outside the vehicle and Officer 4 inside the vehicle.

Officer 5 is positioned at the rear of the vehicle and controls the insertion of the LSB under the patient.

Step 4

Officer 3 positioned at the patient's pelvis rotates the back of the seat rewards as far at it will go as it is providing no support for the patient.

Step 5

Officer 1 & 2 positioned at the patients torso then insert a jacket style Cervical Extrication Device (CED) under the patient. Using the CED as a torso splint, rotate the patients torso upwards towards the back of the seat. It may be of benefit if time persists to attach the chest straps for improved stability.

It will be necessary for the patients head to be carefully rotated to the side by Officer 5 for application of the CED.

VEHICLE ON ROOF - EXTRACTION FROM A SEATBELT

Step 6

Officer 5 positioned at the rear of the vehicle places a blanket over the broken glass of the rear window to allow the LSB to easily slide in and out of the vehicle. Failure to do this may result in severe LSB vibration during extraction. Officer 5 then inserts the LSB through the rear window and into the steering wheel for stability, and for reduced dropping height of the patient when released from the seatbelt.

Officer 3 positioned at the patient's pelvis assists Officer 5 ensuring the LSB is inserted into the steering wheel.

Step 7

Officer 4 cuts the patient's seatbelt.

Officers 3 & 4 positioned at the patient's pelvis uses the seatbelt to lower the patient onto the LSB, and ensure the patient's legs rotate either side of the steering wheel.

Officers 1 & 2 positioned at the patient's torso, at the same time, support the patient in the horizontal position with the CED, slowly lowering the patient onto the LSB in conjunction with Officers 3 & 4.

VEHICLE ON ROOF - EXTRACTION FROM A SEATBELT

Step 6

Begin the slide out of the vehicle on the LSB by:

Officers 1 & 2 positioned on the either side of the patient's torso assist in the sliding of the patient onto the LSB by grasping handles on the CED.

Officers 3 & 4 positioned on the either side of the patient's pelvis assist in the sliding of the patient onto the LSB by grasping the patients clothes at the pelvis.

Officer 5 continues to support the LSB to prevent the LSB from slipping out of the steering wheel.

The patient is slid up the LSB in 30 cm movements until the patients shoulders are level with the shoulder markings on LSB.

Once the patient is correctly positioned of the LSB, slide the LSB carefully out of the steering wheel and out of the vehicle, placing it on the ground.

Step 7

With the patient extracted prone (on their stomach) carry the patient to a safe place and log roll the patient using the log roll 5 person prone 180º technique (page 111) to get the patient supine, then immobilise (pg 208 - 217).[1]

The patient can now be safely carried to the Ambulance stretcher.

Bibliography

1. Victorian Ministerial Task Force on Trauma
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2.. Trunkey
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Trauma.

SCOOP STRETCHER APPLICATION

INTRODUCTION

Initially designed in the late 1960's, the Scoop Stretcher is an English concept offering a way of lifting a patient in the position they are found, whether they are in a supine, prone or lateral position. If correct techniques are applied, there will be minimal movement of the patient during the application, especially in comparison to other methods including the log roll, straddle lift or using the Jordon Lifting Frame.

In direct comparison studies, the DHS Scoop Stretcher has been shown to be the preferred Scoop Stretcher with the studies quoting improved comfort and stability for the patient.[1-4] The improved stability allows the DHS Scoop Stretcher to be used safely for Full Spine Immobilisation. If the other makes of Scoop Stretchers are to be used on a spinal patient, then they must be used in conjunction with a Long Spine Board for proper spinal stability.[5-8]

TECHNIQUES FOR USING THE SCOOP STRETCHER

SKIN PINCHING DURING APPLICATION

Pinching by the Scoop Stretcher will generally only occur at the shoulders and bottom regions of the patient as this is where the greatest patient contact to the ground is.

This pinching can be overcome by simply pulling the patient's clothing out laterally at their shoulders and bottom when sliding the plates under the patient. Never pull upwards as this pushes the patient's shoulders and pelvis anteriorly which may result in spinal column movement.

Pinching will also occur if the Scoop Stretcher is used on surfaces it was not designed for, such as beds, uneven or rough ground, etc. In these situations, pinching may still occur even if the patient's clothing are pulled laterally. If the Scoop Stretcher is to be used on a bed or hospital trolley, then apply the Scoop Stretcher going underneath both the patient and sheet. Pulling the sheets tight while sliding the sides of the Scoop Stretcher under will help resolve any pinching that may otherwise occur.

Pull clothing laterally to prevent the Scoop Stretcher pinching

OVERCOMING DIFFICULTY IN CLOSING HEAD OR FOOT ENDS

Due to improved rigidity of the DHS Scoop Stretcher, on occasions it may be difficult for one Officer alone to close either the head or foot end unless excessive force is applied to both sides. This appears to occur more often on larger patients.

To overcome this problem, a second Officer can apply a small amount on lateral inward pressure on both sides of the Scoop Stretcher no more that 30 cm down from the locking pin. The sides will then come together easily.

Closing the Scoop Stretcher

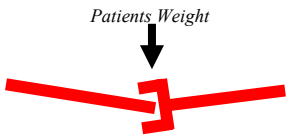
OVERCOMING JAMMING OF THE HEAD AND FOOT LOCK COUPLINGS

The lock couplings for the head and foot ends of the DHS Scoop Stretcher have been designed to jam when any weight is on the Scoop Stretcher plates. This is an intentional design feature so that if the lock release is accidentally depressed while a patient is being carried on the device, the lock will not open.

Overcoming this jamming problem when opening and closing the Scoop Stretcher, simply requires the Officer to bring the male and female ends of the couplings in line with each other (top). Some practice is required to master the technique.

Holding the Scoop Stretcher couplings correctly - one hand on either side of the lock with thumbs on the top - makes operating the locks easier.

Correct position for opening lock



Patient lying on Scoop Stretcher

No patient on Scoop Stretcer

OVERCOMING PINCHING ON LOWERING THE SCOOP ONTO A SURFACE

Pinching by the Scoop Stretcher when lowering in onto another surface may occur because there is slight lateral spreading of the Scoop Stretcher plates when the Scoop Stretcher is picked up. If the Scoop Stretcher is lowered too quickly, the plates move back together before the skin has a chance to move out of the gap and the patient's skin is pinched between the plates and undersurface.

To overcome this problem, always lower the foot end of the Scoop Stretcher first, then lower the head end slowly.

Lowering the Scoop Stretcher

ADJUSTING THE LENGTH

Lengthening before splitting

The length of the DHS Scoop Stretcher should be adjusted before the Scoop Stretcher is split open.

If this does not occur and the Scoop Stretcher needs to be lengthened or shortened after the patient is on the Scoop Stretcher, this is easy to achieve as long as pressure on the leg extension plate is removed. If the Officer forgets to adjust the length before application, fully extend both sides and leave the locks loose until after the application of the Scoop Stretcher.

When changing the length, if pressure remains on the plates, the leg extension section may jam, as the leg extension pole must be aligned to the hole which it is to slide into. The tight fit is essential for stability of the Scoop Stretcher for SCI patients and to reduce lateral spreading of the plates that occurs when the weight of the patient is taken up by the Scoop Stretcher.

Adjusting length after splitting

To lengthen or shorten the Scoop Stretcher, lift the patient's legs off the foot plate and it will slide easily.

Periodic lubrication of the leg extension poles with a dry stick lubricant will also help.

BARE SKIN APPLICATION

If the Scoop Stretcher is applied to bare skin, the skin will stick to the plates and drag the skin causing pinching to occur. To overcome this problem either:

- Place talcum powder over the Scoop Stretcher plates.
- Place baby oil or suntan lotion over the Scoop Stretcher plates.
- Place a sheet over each of the Scoop Stretcher plates.

DEFIBRILLATING ON THE SCOOP STRETCHER

Defibrillation is safe on the Scoop Stretcher as long as all standard safety precautions are taken.

RAISING THE HEAD OF THE BED FOR TRANSPORT

If the head of the stretcher is raised by one notch, the patient can be transported on the Scoop Stretcher with no pressure on the spinal column as would occur with the Long Spine Board, as a gap will form between the Scoop Stretcher and the Ambulance Stretcher. This is especially advantageous if a dislocation of the vertebrae has occurred, or swelling within the spinal column is developing.

PRE-STRAPPING FOR LARGE PATIENTS

If a large patient is to be immobilised on the Scoop Stretcher, it is worthwhile pre-lengthening the straps and attaching them to the Scoop Stretcher before bringing the Scoop Stretcher's sides together. This will save 'Fighting The Fat' to locate the speed-clip attachment pins.

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SIDE BY SIDE APPLICATION OF THE SCOOP STRETCHER

Training Requirements:	**2 x Staff** **1 x Patient** **1 x Scoop Stretcher**

The Side-By-Side application of the Scoop Stretcher is preferred over the Scissor application (pg 204 - 207) when the patient is prone, on a bed, trolley or uneven surface, or when the patient is not fully clothed.

Points To Remember:

- *Use the Scoop Stretcher only on flat surfaces.*
- *Pull patient's clothing tight at the shoulders and bottom to prevent pinching.*
- *Pull patient's clothing out laterally, never upwards, otherwise spinal column movement may occur.*
- *Minimal movement of the patient should occur during the application.*

In this procedure, the Officer's limb closest to the patient's head will be referred to as the Officer's upper limb, and the Officer's limb closet to the patient's feet will be referred to as the Officer's lower limb.

Procedure

Step 1

Both Officers place the Scoop Stretcher at the patient's side.

Step 2

Extend the Scoop Stretcher to the correct length before splitting. For measuring the device, position the Scoop Stretcher so that a Shoulder speed clip attachment point lies 1 cm below the level of the patient's shoulders.

SIDE BY SIDE APPLICATION OF THE SCOOP STRETCHER

Loosen the leg extension locks and adjust the leg section to the correct length (heels of patient's feet level with the bottom of the foot plate). Re-tighten locks to finger pressure only.

Step 3

Split Scoop Stretcher in half and place appropriate sections on either side of the patient.

Step 4

To apply the Scoop Stretcher, both Officers now move to same side of the patient.

SIDE BY SIDE APPLICATION OF THE SCOOP STRETCHER

Step 5

Officer 1 at the patient's chest, grasps patient's clothing at the shoulder with their upper hand and gently pulls the clothing tight laterally to prevent pinching during the Scoop Stretcher application. Officer 1's lower hand is placed on the side of the Scoop Stretcher lower down.

Officer 2 at the patient's pelvis grasps the patient's clothing at the patient's bottom with his upper hand and gently pulls the clothing tight laterally to prevent pinching during the Scoop Stretcher application. Officer 2's lower hand is placed on the side of the Scoop Stretcher at the leg extension pole. It has been shown that when Officers try other hand placements, application is not as easy or as quick.[1]

The side of the Scoop Stretcher is slowly and gently slid under the patient until it is approximately half-way under the patient.

Step 6

Both Officers move to the opposite side of the patient and carry out step 5 again until the locking mechanisms at the head and foot ends are touching.

SIDE BY SIDE APPLICATION OF THE SCOOP STRETCHER

Step 7

Both Officers now move to the head end of the Scoop Stretcher. Whilst Officer 1 closes the head locking mechanism, Officer 2 places lateral inward pressure on the sides of the Scoop Stretcher - no more than 30 cm from the locking pin - to allow the 2 halves of the lock to come together easily.

Step 8

Officer 2 moves to the foot end of the Scoop Stretcher and closes the foot locking mechanism.

At the same time, Officer 1 straddles over the patient and pulls the clothing laterally at the patient's pelvis, while helping to close the locks by pushing his heels against the extension poles.

Step 9

The patient can now be immobilised to the Scoop Stretcher for transport (pg 208 - 215).

If the patient is supine on the Scoop Stretcher, place the Scoop Stretcher on the Ambulance stretcher with the head of the stretcher pre-raised one notch so that there is no pressure on the patient's spinal column.

SCISSOR APPLICATION OF THE SCOOP STRETCHER

Training Requirements:	**1 x Staff** **1 x Patient** **1 x Scoop Stretcher**

The Scissor application of the Scoop Stretcher is often preferred over the Side-By-Side application when the patient is supine or in a confined space such as a hallway. Application time can be as little as 40 seconds using this method.

Points To Remember:

- *Use the Scoop Stretcher only on flat surfaces.*
- *Pull clothing tight at the shoulders and bottom to prevent pinching.*
- *Pull clothing out laterally, never upwards, otherwise spinal column movement occurs.*
- *Minimal movement of the patient should occur during the application.*

Procedure

Step 1

The Officer places the Scoop Stretcher at the patient's side.

Extend the Scoop Stretcher to the correct length before splitting. For measuring the device, position the Scoop Stretcher so that the shoulder speed clip attachment point lies 1 cm below the level of the patient's shoulders.

Loosen the Scoop Stretcher's leg extension locks and adjust the leg section to the correct length (patient's heels of feet level with the bottom of the foot plate). Re-tighten locks to finger pressure only.

SCISSOR APPLICATION OF THE SCOOP STRETCHER

Step 2

Split the Scoop Stretcher at the foot end (leaving head end closed) and straddle over the patient's legs.

Step 3

The Scoop Stretcher is now laid on the ground with the bottom of the body plates level with the patient's upper arms.

Slide the Scoop Stretcher down the patient into position until the head locking mechanism is 2 cm above the top of the patient's head.

SCISSOR APPLICATION OF THE SCOOP STRETCHER

Step 4

The Officer now grasps the patient's clothing at their shoulders and gently pulls the clothes tight laterally to prevent pinching during the application.

The Officer then places their feet against the sides of the Scoop Stretcher, with the heels of the feet against the Scoop Stretcher, begins to push the side plates of Scoop Stretcher under the patient until the plates touch the patients bottom.

Step 5

The Officer now moves down to the patient's pelvic region and again straddles over the patient. The Officer then grasps the patient's clothing at the patient's bottom and gently pulls the clothes out laterally so that they are tight (to prevent pinching).

The Officer's feet are placed against the sides of the Scoop Stretcher, and with the heels of the feet at the leg extension poles, begins to push the side plates of Scoop Stretcher under the patient until both sides of the foot locking mechanism touch.

SCISSOR APPLICATION OF THE SCOOP STRETCHER

Step 6

Once both sides of the foot locking mechanism touch, the Officer turns around, again places his feet against the sides of the Scoop Stretcher with their heels at the leg extension poles, provides inward lateral pressure with the heels of their feet and closes the locking mechanism.

Step 7

The patient can now be immobilised to the Scoop Stretcher for transport (pg 208 - 215).

If the patient is supine on the Scoop Stretcher with a potential or actual SCI, place the Scoop Stretcher on the Ambulance stretcher with the head of the Ambulance stretcher pre-raised one notch so that there is no pressure on the spinal column.

FULL SPINE IMMOBILISATION

FULL BODY IMMOBILISATION

INTRODUCTION

The following section is a detailed photographic guide to Full Body / Spine Immobilisation using the Neann Long Spine Board (LSB) or DHS Scoop Stretcher using the Speed-Clip Strapping System. The techniques offered are based on current research and x-ray studies and offer the most up to date teaching.[1-5]

There is increasing questioning by some of the need to immobilise the full spine, with suggestions that immobilisation does not prevent further SCI, but may actually cause such injuries.[6] *Whilst a Medline literature search failed to find any studies supporting the theory that immobilisation onto a LSB causes secondary cord injury, a number of studies have shown that failure to identify and immobilise patients with unstable fractures do acquire secondary cord deterioration.*[7] *Recent studies looking at prehospital SCI & field clearance failed to establish any secondary SCI on any patients correctly immobilised during transport.*[8-9]

A number of studies in the literature do present complications when ***POOR STANDARDS*** *of immobilisation are performed. Issues include occipital, lumbar and sacral pain development when padding is inadequate or absent,*[10-14] *increased respiratory compromise with incorrect chest strapping,*[15-16] *pressure sore development due to inadequate padding*[2-4] *and spinal miss-alignment again due to inappropriate padding.*[2, 14, 17] *When proper consideration is given, such complications are significantly reduced or avoided.*[1-5]

Training Requirements:	**2 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Long Spine Board** **1 x Blanket** **1 x Towel** **1 x Hand / Wrist Airsplint** **7 x Speed Clip Straps … 5 x Yellow** **… 1 x Red** **… 1 x Blue** **2 x Head Blocks** **1 x Head Tape Roll**

Procedure

Step 1

Place 1 - 2 blankets down the full length of the LSB. This will provide significantly improved comfort, reduce pressure sore development, limit vibration to the patient during both road and helicopter transport, and prevents heat loss to the patient through lying on the LSB.

Place adequate padding under the patient's lumbar spine and head to fill the gaps formed by the anatomical curvature of the spine.

In adults, firm padding using a folded towel or similar (**NOT PILLOWS**) is generally required under the patient's head to prevent hyperextension of the cervical spine,[14, 17] while in children under 8 years of age, padding under the torso rather than the head is generally required to prevent hyperflexion of the cervical spine.[19-20] Some adults and children will however require no padding.

For the patient's lumbar spine, a hand / wrist airsplint (which is inflated once in position) is the easiest method of padding under the lumbar region.

NOTE

Position Speed-Clip Straps near the LSB within easy reach.

To ease and rapidly speed up application of straps, it is best to stand straddled over the patient.

In a potential or actual SCI, one person should also continue Manual In-Line Stabilisation of the head (pg 55 - 60) until the head blocks (Step 7) are attached. A Cervical Collar alone has been shown in numerous studies to be ineffective in maintaining adequate cervical spine immobilisation.[21-24]

Step 2

The Officer applies first and second yellows straps across the patient's chest in a crossing application with the adjustable ends at the patient's pelvis. Following application of the straps, there should be just enough slack to allow one hand to be placed between the patient's chest and the strap. The straps should be placed over the patient's clavicle and attached to the pelvic hand hold on the opposite side.

These first two straps will prevent upward sliding of the patient's body when the LSB is tilted head down, or when the brakes of the vehicle are applied during transport. They will also help prevent lateral movement of the patient's torso if the LSB needs to be tilted sideways.[26]

Step 3

Place a yellow strap across the patient's pelvic bone or iliac crest. Ensure that the strap goes over the pelvic bone rather than the soft abdomen otherwise abdominal organ damage may occur.

This pelvic strap will help prevent lateral movement of the patient's spinal column.

Step 4

Using the blue strap, the Officer applies a 'Figure Of Eight' around the patient's ankles to prevent downward sliding of the patient on the LSB that may occur if the foot end of the LSB is tilted downwards, or when the Ambulance accelerates. This strap will also help prevent lateral movement of the patient's legs.

Step 5

Place the red strap across the patient's femur. Extra padding using rolled up towels on each side of the patient's legs may be required for patients with small legs. If the patient's legs are able to move laterally, spinal column movement including the cervical spine can still occur.[25]

Step 6

One further strap can be placed loosely over the patient's chest region so as to support the patient's upper arms from flopping around, to help prevent lateral spinal column movement;[9] and to help prevent the patient's upper arms from moving above shoulder height. Raising the patient's arms above the shoulder level as required for such manoeuvres as the Canadian Log roll is in general **CONTRA-INDICATED** in SCI, as studies have shown this causes sagging of the thoracic and lumbar spine.[26-27]

Step 7

Once the patient's body is secured properly to the LSB, **ONLY THEN** is the patient's head secured to the LSB. Ensure the correct amount of firm padding (using a towel, not a pillow) is under the patient's head to maintain the patient's spine in the neutral in-line position (generally around 2 - 7 cm in an adult). Now place either commercially available Head Blocks or home made Head Rolls (using rolled blankets or towels) on each side of the patient's head. Using 2 - 5 cm tape, tape the Head Blocks and patient's head to the LSB going initially across the Cervical Collar and then across the patient's forehead. The tape should not be place over the patient's lower jaw as this will clamp the jaw closed therefore interfering with airway management.

Summary

The patient can now be log rolled, tilted, vertically or horizontally lifted, stood up, etc with almost no movement to the patient's body and spinal column. This should be maintained until an X-Ray can confirm or exclude the presence of an unstable spinal column.

The curved LSB will also allow for slight tilting of the LSB every 20 minutes to assist with pressure area care (a procedure that cannot be achieved when the patient is laid on a stretcher or flat LSB).

ALTERNATIVE STRAPPING TECHNIQUES

Depending on the patient's injuries and the purpose of strapping, the positions of the straps may need to be changed from the application presented previously (pg 209 - 212).

Potential or Actual SCI With Leg Fractures

If a patient has leg fractures, then the lower leg straps will not be able to be used to prevent downward sliding of the patient's torso.

Instead of the leg & ankle straps to stop the torso sliding down the LSB or Scoop Stretcher, use groin straps as shown. Straps over the upper and lower legs will still be required to stop lateral movement of the patient's legs and help secure the fracture.

Securing A # NOF Or # Pelvis

To secure a patient with a # NOF or # Pelvis to a LSB or Scoop Stretcher, both shoulder straps, femur strap and a figure-of-eight ankle strap will still be required to stop the patient's torso sliding up and down the LSB or Scoop Stretcher.

Modification is however made to the pelvic strap by using a cross over strapping method over the pelvis as depicted in the photo. While these straps place no pressure over the NOF / pelvic area, they adequately splint the area to the LSB or Scoop Stretcher, immobilising the joints above and below the fracture sight.

With proper padding under the patient using 1 - 2 blankets, lumbar support and padding under the head, the patient can remain on the LSB or Scoop Stretcher for an extended period of time in comfort.

ACCESSORIES FOR FULL SPINE IMMOBILISATION

To assist with Full Spine / Body Immobilisation, additional equipment to the Long Spine Board and Scoop Stretcher is required. It is also helpful if all this additional equipment is prepared and stored in a single Carry Bag, so that the accessory items can be easily carried to the patient and no time is wasted searching for the equipment.

The following spinal immobilisation accessories listed below, should be considered:

SPINE IMMOBILISATION EQUIPMENT CARRY BAG

Items carried include:

- *Full Set Of Cervical Collars*
- *Velcro Speed Clip Straps - 5 x Yellow Straps*
- *- 1 x Blue Ankle Strap or 8 x Clip-Lock Belts*
- *- 1 x Red Femur Strap*
- *3 x Towels - 1 for padding under the head*
  - 2 for padding out the femurs
- *2 x Head Blocks or Double Towel Rolls*
- *2 x Head Immobilisation Tape (2.5 or 5 cm width)*
- *1 x Blanket or commercially available Board Padding*
- *1 x Hand / Wrist Airsplint with Extension Tubing - to pad under lumbar spine*
- *1 x Rapid Extrication Strap*

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VACUUM MATTRESS

INTRODUCTION

In the late 1960's, a Swede named Erik Runereldt was in a local supermarket watching coffee beans being vacuum sealed into paper packets and envisaged this to be an excellent concept for the packaging of trauma patients. His idea was to become known as the Vacuum Mattress and began being introduced into the prehospital setting in some European countries.

In the 1990's, continuing failure of Officers to adequately pad Long Spine Boards, and patients remaining on Long Spine Boards for extended lengths with resulting discomfort and pressure sore development, saw an increase in the use of the Vacuum Mattress beyond Europe. Whilst not a replacement for the versatile Long Spine Board, the Vacuum Mattress is excellent as a secondary transport device for the trauma patient.

Vacuum Mattress

PRIMARY ROLE

The Vacuum Mattress is primarily a full spine / body immobilisation transportation device, but is also excellent as a transportation splinting device for patients with pelvic, NOF or extremity fractures.

INDICATIONS OF USE

The Vacuum Mattress is indicated for use as a full spine / body immobilisation device where:[9-11]

1. **Signs & symptoms of potential or actual spinal cord / column injury exist**

OR

2. **Mechanism of Injury exists without signs & symptoms of spinal cord / column injury AND the patient has one or more of the following:**
   - **Altered Conscious State**
   - **Alcohol / Drug Consumption**
   - **Distracting Injury or event**
   - **Modifying Factors (including language barrier, extremes of age, intellectual disabilities)**

LIMITATIONS OF USE

The Vacuum Mattress's material gives it only limited durability against glass, metal and other sharp objects in the prehospital environment. It use should therefore be limited to leaving the Vacuum Mattress on the Ambulance stretcher and taking the patient to the Vacuum Mattress rather than Vacuum Mattress to the patient. It is of most benefit where the patient will require immobilisation for greater than 1 hour.

VACMAT COMPONENTS

The VacMat is one of numerous Vacuum Mattresses on the market, but is specifically designed to meet the latest requirements in prehospital spine immobilisation.

Consisting of a outer polyester fibre PVC shell, with an woven inner lining that contains 1000's of styropor granules about 1mm in diameter, as air is evacuated from the VacMat with it's foot pump, the styropor granules clump together to form a rigid platform that allows immobilisation of the patient.

Components of the VacMat include:

CARRY BAG

The VacMat comes with a backpack storage unit for ease of carrying and storage of the device.

OUTER COVER

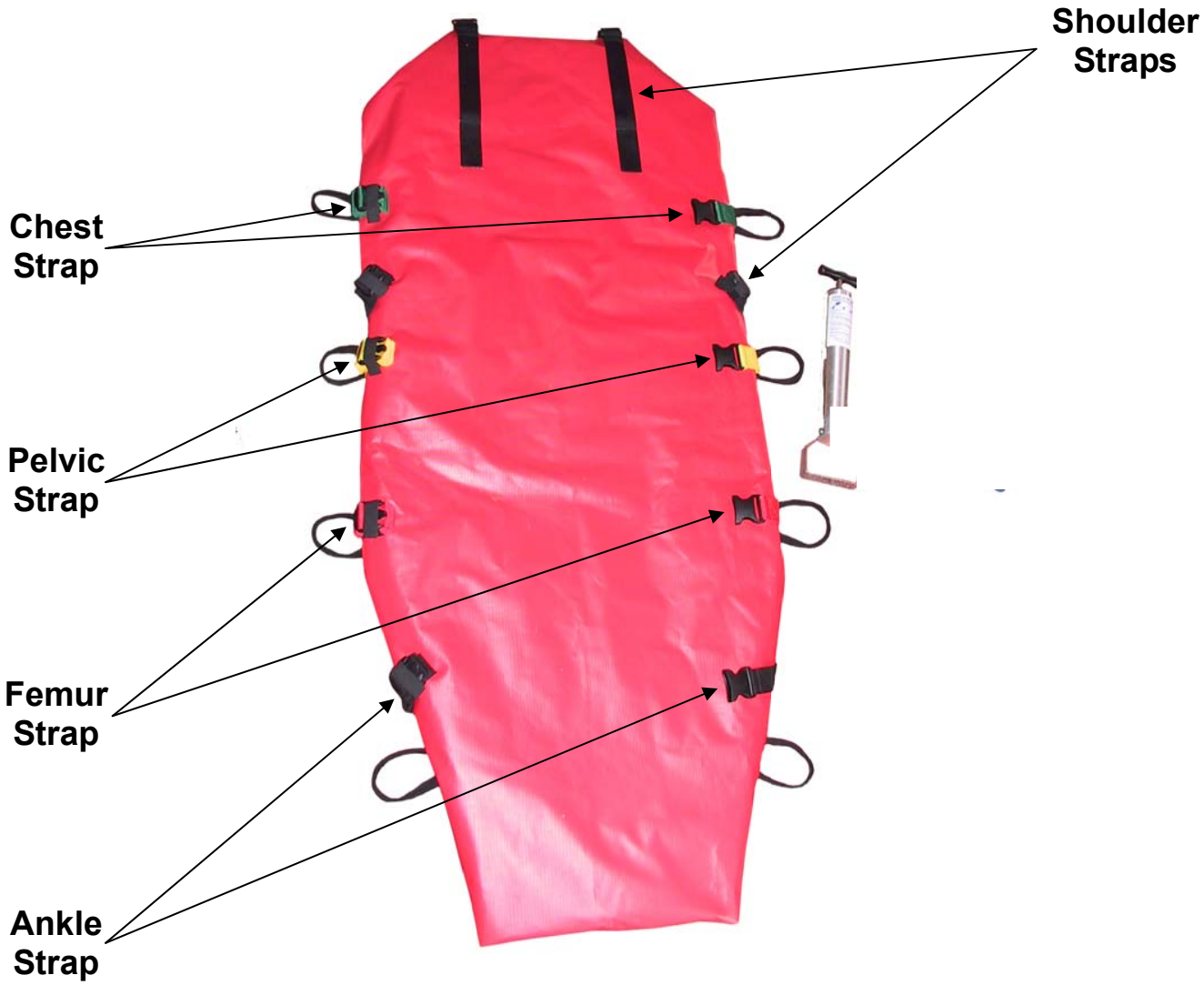
The VacMat comes with zip off outer cover to protect the main mattress from wear & tear, and for ease of cleaning.

FOOT PUMP

The VacMat comes with a foot pump for rapid removal of the air.

IMMOBILISATION STRAPS

The VacMat comes with a range of straps which meets the latest requirements in spine immobilisation and include:



CARRY HANDLES

The VacMat comes with 4 carry handles down each side for moving the VacMat.

The handles should not be used for carrying actual or potential SCI patients. In these cases, the VacMat should be carried on a Long Spine Board or Scoop Stretcher for proper stability.

HEAD & CHIN STRAPS

Uniquely designed head & chin straps are supplied with VacMat.

These are stored in a pouch found on the underneath side of the VacMat's outer cover.

AIR VALVE

The air valve on the VacMat is found on the under side. Turn the valve clockwise to close and seal the VacMat keeping it rigid. Turn the valve anticlockwise to allow air to enter the VacMat.

STRAP STORAGE

The VacMat straps are held in place by elasticised straps.

Straps should be folded in a zig zag manner for easy unfolding at the scene.

IMMOBILISATION TO A VACMAT

The following section is a detailed photographic guide to Full Body / Spine Immobilisation using the Neann VacMat. These techniques offered are based on current research and x-ray studies and offer the most up to date teaching.[1-5]

There is increasing questioning by some of the need to immobilise the full spine, with suggestions that immobilisation does not prevent further SCI, but may actually cause such injuries.[6] *Whilst a Medline literature search failed to find any studies supporting the theory that immobilisation causes secondary SCI, a number of studies have shown that failure to identify and immobilise patients with unstable fractures do acquire secondary cord deterioration.*[7] *Recent studies looking at prehospital SCI & field clearance failed to establish any secondary SCI on any patients correctly immobilised during transport.*[8-9]

A number of studies in the literature do present complications when ***POOR STANDARDS*** *of immobilisation are performed. Issues include occipital, lumbar and sacral pain development when padding is inadequate or absent,*[10-14] *increased respiratory compromise with incorrect chest strapping,*[15-16] *and spinal miss-alignment again due to inappropriate padding.*[2, 14, 17] *When proper consideration is given, such complications are significantly reduced or avoided.*[1-5]

Training Requirements:	**2 x Staff** **1 x Patient** **1 x Cervical Collar** **1 x Scoop Stretcher** **1 x VacMat** **1 x Stretcher Canvas** **1 x Towel** **1 x Hand / Wrist Airsplint** **1 x Head Straps**

Procedure

Step 1

Place a stretcher canvas or sheet down the full length of the VacMat. This will ease removing the patient off the VacMat, and helps prevents heat loss of the patient through lying on the VacMat.

Undo the straps on VacMat and lay to the side.

Step 2

Officers place the patient onto the VacMat using the Long Spine Board or Scoop Stretcher and then remove it from the VacMat.

Ensure the patients shoulders are 2 - 3 cm above the sew down point of the black shoulder straps.

Step 3

Officers place adequate padding under the patient's head and lumbar spine to fill the gaps formed by the anatomical curvature of the spine. The VacMat does not always fill these gaps adequately, especially under the head.

In adults, firm padding using a folded towel or similar (**NOT PILLOWS**) is generally required under the patient's head to prevent hyperextension of the cervical spine,[14, 17] while in children under 8 years of age, padding under the torso rather than the head is generally required to prevent hyperflexion of the cervical spine.[19-20] Some adults and children will however require no padding. If no spinal injury is suspected, a pillow can be substituted for the towel to improve patient comfort.

For the patient's lumbar spine, occasionally padding may be required to fill the lumbar region. A hand / wrist airsplint (which is inflated once in position) is the easiest method to achieve this.

NOTE

In a suspected SCI, one Officer should also continue Manual In-Line Stabilisation of the patient's head (pg 55 - 60) until the head is immobilised to the VacMat (Step 9). A Cervical Collar alone has been shown in numerous studies to be ineffective in maintaining adequate cervical spine immobilisation.[21-24]

Step 4

Officers apply both black shoulder straps across the patient's chest in a crossing application. Following application of the straps, there should be just enough slack to allow one hand to be placed between the patient's chest and the strap. Over tightening will compromise the patient's respiratory effort.[15-16]

These first two straps will prevent upward sliding of the patient's body when the VacMat is tilted head down, or when the brakes of the vehicle are applied during transport. They will also help prevent lateral movement of the patient's torso if the VacMat needs to be tilted sideways (eg vomiting patient).[26]

Step 5

Officers apply the green chest strap over the patient's chest region only firm enough so as to support the upper arms of the patient from flopping around; to help prevent lateral spinal column movement;[9] and to help prevent the patient's upper arms from moving above shoulder height. Raising the arms above the shoulder level as required for such manoeuvres as the Canadian Log roll is in general **CONTRA-INDICATED** in SCI, as studies have shown this to cause sagging of the thoracic and lumbar spine.[26-27]

Step 6

Officers apply the yellow pelvic strap across the patient's pelvic bone or iliac crest. Ensure that the strap goes over the pelvic bone rather than the soft abdomen otherwise abdominal organ damage may occur.

This strap will help prevent lateral movement of the patient's spinal column.

Step 7

Officers place the red femur strap across the patient's upper legs. If the patient's legs are able to move laterally, spinal column movement can occur.[25]

Step 8

Using the black foot strap, Officers apply a 'Figure Of Eight' around the patient's ankles to prevent downward sliding of the patient on the VacMat that may occur if the foot end of the VacMat is tilted downwards, or when the Ambulance accelerates. This strap will also help prevent lateral movement of the patient's legs.

Step 9

Once the patient's body is secured properly to the VacMat, **ONLY THEN** do Officers secure the patient's head to the VacMat. Ensure the correct amount of firm padding (using a towel) is under the patient's head to maintain the patient's spinal column in the neutral in-line position (generally around 2 - 7 cm in most adults).

Officers apply the 25mm Collar Strap by attaching side hook velcro tabs to the velcro on the mattress. Tighten strap by ensuring foam pad is centred on Cervical Collar (away from chin support), with the Officer placing their thumbs on centre of strap, and pulling both ends with equal pressure. Place only enough pressure to prevent movement, but not to deform the Cervical Collar or place pressure on the jaw line. Velcro into place. Under no circumstances is pressure to be placed on the patient's jaw line as this may clamp the mouth shut, compromising the patients airway. If no Cervical Collar can be applied, tighten the strap by ensuring the foam pad is centered on maxilla just under the patient's nostrils, placing thumbs on center of strap, and pulling both ends with equal pressure. Velcro into place.

Officers apply the 50mm Forehead Head Strap by attaching side hook velcro tabs to velcro , ensuring the forehead head strap bottom aligns with bottom of patient's eyebrows. Tighten the strap ensuring the foam pad is centered on forehead, with the Officer placing their thumbs on center of the patient's forehead, and pulling both ends with equal pressure. Velcro into place.

Step 10

Once all the strapping is applied is applied to the patient, the Officer attaches the foot pump and pumps all the air out of the VacMat.

Step 11

The Officer now readjust straps following evacuation of the air out of the VacMat as the straps will loosen off.

Step 12

The patient is now fully immobilised to the VacMat and ready for moving.

Step 13

Secure the VacMat to the Ambulance stretcher ready for transport.

ACCESSORIES FOR THE VACMAT

To assist with Full Body Immobilisation, additional equipment to the VacMat is required. It is also helpful if all this additional equipment is prepared and stored in the Carry Bag, so that the accessory items can be easily carried to the patient and no time is wasted searching for the equipment.

The following equipment & spinal immobilisation accessories listed below, should be considered:

VACMAT CARRY BAG

Items carried include:

* VacMat & Outer Cover (attached)
* Head & Chin Straps
* Foot Pump
* Full Set Of Cervical Collars
* 1 x Towel for padding under the head
* 1 x Stretcher Canvas
* 1 x Hand / Wrist Airsplint with Extension Tubing
  - to pad under lumbar spine

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CONSIDERATIONS OF SCI IN PAEDIATRICS

INTRODUCTION

Paediatric spinal care requires a modified approach to immobilisation to that of the adult patient. The following discusses the essential differences in treating the child patient versus the adult patient.

HEAD SIZE

Children under the age of 8 years have what is often referred to as the "Charlie Brown Effect', that is the head is larger than the body, with the majority of the enlarged head of the child posterior to the spinal column. It has been shown that if the child was therefore to be placed on a flat board, then the head would be pushed into a hyperflexed position.[1-3]

Charlie Brown Effect - No padding

It is essential therefore to place padding under the complete torso from the shoulder down to the bottom. Methods where padding is placed only under the shoulders causes hyperflexion of the thoracic and lumbar spine.[4]

To overcome this, always place 7 cm of firm padding under the child's torso. While this will elevate the torso more than required in many cases, the gap under the head can then be padded out. This technique overcomes the chances of under judging the amount of padding required under the patient's torso and removes the need for additional log rolls until correct padding is found.

Padding with blanket

TYPES OF SCI

Spinal fractures in children are a rare occurrence[4, 5] with the majority of SCI being elongation of the spinal cord and shearing damage to the nerves in the spinal cord.[5] This is due to the fact that the muscles and ligaments in the child's spinal column are much weaker in comparison to the adult. As a result, these muscles and ligaments are unable to resist tractional forces effectively.[5, 6]

As a result, SCI in children often occur without x-ray findings.[5] Therefore never rule out SCI in children on x-ray alone.[5] If a paediatric patient is to be transferred from a Hospital and has been cleared of a SCI only through x-ray, consider re-establishing spine immobilisation until more definitive tests are carried out.[6]

LOCATIONS OF SCI

SCI in paediatrics totals only 3% of all SCI patients.[6] Location of the cervical spine injury in children is most commonly in the upper spine C_1 - C_2, while in adults the most common injury appears to be C_5 - C_6.[5] As semi rigid collars only partially immobilise after the lower spine, it is essential that only rigid collars be used on children. It is well established that no Cervical Collar provided acceptable immobilisation, therefore Cervical Collars must be used in conjunction with a Cervical Extrication Device or a Long Spine Board.[7]

SHOULD YOU IMMOBILISE THE PAEDIATRIC PATIENT WITH A POTENTIAL SCI

There is much controversy as to whether a child should be immobilised. Isolated case reports of SCI occurring in the children struggling against the procedure have been documented.[6-7] There is an opposing view however that young children will often stop fighting when snugly immobilised.[7] Full spine immobilisation in paediatrics is still considered to be appropriate despite rare cases of secondary SCI occurring. It should however be done with careful consideration to prevent the child from becoming agitated and struggling.

USE OF THE SCOOP STRETCHER IN PAEDIATRICS

If a Scoop Stretcher is used on young children under 8 years of age, the gap under the patient may significantly reduce the amount of proper support given to the spinal column. In such children, the use of the Long Spine Board may be the preferred device.

IMMOBILISATION ON A LONG SPINE BOARD OR SCOOP STRETCHER

When immobilising a child onto a Long Spine Board or Scoop Stretcher, a number of adjustments in comparison to an adult are required:

- As children are often a lot narrower than the Long Spine Board or Scoop Stretcher, blanket rolls will need to be placed down each side of the child's body.
- Placing blanket rolls down each side of the child is at least as effective as Paediatric Spine Immobilisers currently on the market.
- The strapping method used should be a criss-cross pattern which still includes shoulder straps and the figure-of-eight around the ankles.

For children under 8 years of age, padding under the child's complete torso is generally required.[1-3]

ALTERNATIVE PAEDIATRIC IMMOBILISATION METHODS

While the child can be immobilised onto a Long Spine Board or Scoop Stretcher, other alternatives are available:

If the infant or child is sitting in a capsule or car seat, these can be utilised as effective immobilisers and with less stress to the child as compared to the child being strapped to a Long Spine Board or Scoop Stretcher.

The use of the CED or Vacuum Splints also make ideal Full Spine Immobilisers for infants and still allow the child to be nursed by the parents.

CED Paediatric Immobilisation

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