



PUBLIC SAFETY & AQUATIC RESCUE TRAINING MANUAL

35th EDITION





Module 9: Spinal Management

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The spinal cord

The spinal cord is a collection of nervous tissue connecting the brain to the body. The spinal cord is surrounded for most of its length by the bones (vertebrae) that form the spine, and which protect the soft spinal cord from injury. The cord runs through the oval shaped opening in each vertebra. The vertebrae are stacked on top of one another and are separated by spongy discs that act as shock absorbers between each vertebra.

The spinal cord is divided into four sections: cervical, thoracic, lumbar and sacral. There are 31 pairs of spinal nerves that connect with the spinal cord through nerve roots, which extend from the spinal cord from either side of the spinal column. Each spinal nerve relates to a different section of the body.

The spinal nerves are:

- 8 in the cervical vertebrae
- 12 in the thoracic vertebrae
- 5 in the lumbar vertebrae
- 5 in the sacral vertebrae.

Common causes of spinal cord injury

Each year in Australia, between 300 and 400 people sustain traumatic spinal cord injuries (SCIs); mostly as a result of car accidents and falls. If a vertebra is broken and a piece of the broken bone presses into the spinal cord, the cord will be injured. The cord can also be injured if the vertebrae, which are normally held in place by strong ligaments and muscles, are pushed or pulled out of alignment, even if they are not fractured. Spinal injuries in aquatic based activities usually occur in the cervical (neck) section of the spine as a result of a traumatic force, such as diving into shallow water.

When being assessed for spinal injury approximately only 50 per cent of victims show recognised symptoms or signs of spinal damage. Therefore, it is important that if a spinal injury is suspected that the victim is managed accordingly.

The five common types and causes of spinal cord injuries are:

1. Hyperextension injuries

- Occur when the head is sharply thrust back and the spine is arched backwards beyond its normal limit
- Most commonly result in upper cervical spinal cord injury when there is nothing to restrain the head

Common causes of hyperextension injuries are:

- falling face down whilst climbing stairs
- motor vehicle accidents (whiplash)
- shallow water diving accidents.

2. Hyperflexion injuries

- Occur when the spine is arched forward beyond its normal limit
- Most commonly result in injuries to the cervical spinal cord because the head is pushed forward until the chin makes contact with the chest

Common causes of hyperflexion injuries are:

- during a football/rugby tackle and/or scrum
- falling downstairs
- whiplash.

3. Compression injuries

- Occur when the spinal cord is compressed following impact.
- Most commonly results in injuries to the cervical or thoracic spinal cord because the weight of the body is driven against the head by sudden, excessive compression

Common causes of compression injuries are:

- a heavy object falling on the head
- diving injuries
- jumping from a height and landing feet first.

4. Distraction injuries

- Occur when the spinal cord is overstretched, or pulled apart

Common causes of distraction injuries are:

- hanging
- football/rugby tackles
- gymnastics
- playground injuries to children.

5. Rotation injuries

- Occur when the head and body rotate in opposite directions
- Results in twisting of the muscle, ligaments, vertebrae and/or spinal cord

Common causes of rotation injuries are:

- ejection from a motor vehicle
- motor vehicle injuries.

Classification and level of injury

Spinal cord injuries are classified as complete or incomplete depending on how much of the cord width is damaged. It is very difficult in the prehospital setting to identify whether an injury is complete or incomplete, and the role of the first aider is to minimise movement and protect the patient from further injury.

Complete injuries

Complete spinal cord injury is the term used to describe damage to the spinal cord that is absolute. It causes complete and permanent loss of ability to send sensory and motor nerve impulses and, therefore, complete and usually permanent loss of function below the level of the injury.

Incomplete injuries

Incomplete spinal cord injury is the term used to describe partial damage to the spinal cord. With an incomplete lesion, some motor and sensory function remains. People with an incomplete injury may have feeling, but little or no movement. Others may have movement and little or no feeling.

Level of a spinal cord injury

The level of the spinal cord injury refers to the vertebra that the injury is closest to. When the spinal cord is injured, the brain's ability to communicate with the body below the level of the injury may be reduced or lost. When that happens, the part of the body affected will not function normally.

The closer to the head the spinal cord injury is, the greater the area of the body that may be affected. For example, a person with a thoracic spinal injury may lose use of the legs (paraplegia) but the arms will not be affected. A person with a cervical injury may lose use of the legs and arms (referred to as tetraplegia or quadriplegia).

Signs and symptoms

Spinal cord injury should always be suspected where the patient has dived into shallow water, or potentially sustained one of the injuries suggested by hyperextension, flexion etc. Some patients may present with minimal or no signs or symptoms. If you are in any doubt treat the patient for a spinal cord injury.

Signs suggesting SCI

- Abnormal heart rate (may be fast or slow depending on injury)
- Abrasions or bruising to the head or forehead
- Breathing difficulties
- Dilated pupils
- Fluid leaking from the ears
- Loss of or altered level of consciousness
- Loss of function in hands, fingers, feet or toes
- Loss of bladder or bowel control
- Neck or head in abnormal position
- Priapism (erection) in males
- Shock

Symptoms suggesting SCI

- Back or neck pain
- Feeling of pins and needles
- Headache or dizziness
- Nausea
- Tingling, numbness or abnormal sensation in lower or upper limbs, fingers or toes

Managing a victim with suspected spinal injury

Spinal injuries in aquatic-based activities usually occur in the cervical (neck) section of the spine as a result of a traumatic force, such as diving into shallow water. Victims may be located in or out of the water.

Good management of a victim with a spinal cord injury will minimise the chance of causing more damage, which may further reduce spinal cord function. A victim with a suspected spinal injury should be managed in the following order:

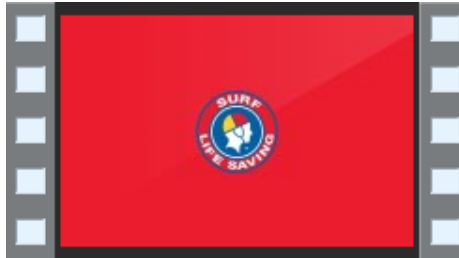
1. move the victim **only** to extract them from danger
2. call an ambulance as soon as possible
3. manage the victim's airway
4. provide spinal care.

Extracting a victim with a suspected spinal injury (aquatic environment)

In all instances where a victim is discovered floating face down within the break zone, they should be considered to have suffered a spinal injury.

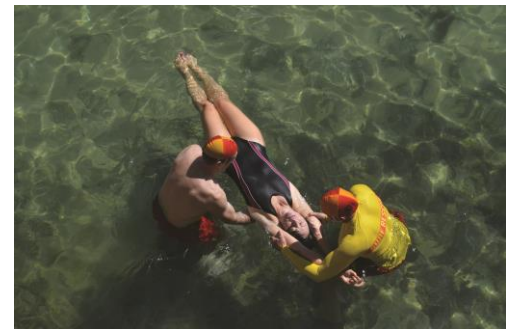
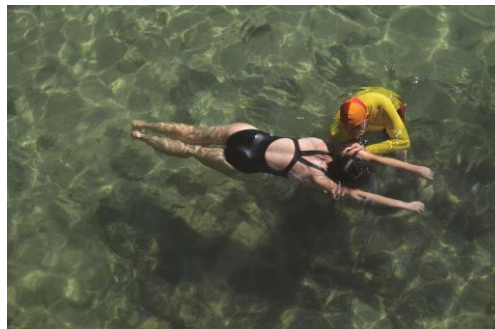
Extracting a victim with a suspected spinal injury from shallow water is a two-part process:

Part 1—Extended-arm roll over



Video - Extended-arm roll over

Perform an extended-arm roll to turn the victim to a face-up position. The extended-arm roll over technique maintains the victim's airway while immobilising their head in the neutral position by pinning the victim's head between their arms. The technique is particularly useful in calm, shallow waters.



First responder (head position/team leader)

1. Call/signal for 'assistance required'.
2. Approach the victim from their head and position your body so that it can protect the victim from oncoming waves.
3. Grasp the victim's upper arms.
4. Manoeuvre the victim's arms so they are placed on either side of the victim's head in alignment with their body. This will stabilise their head in a neutral position.
5. Reach under the victim with one arm to grasp the victim's corresponding arm (e.g., right arm holding right arm) at the level of the ears, holding their arms firmly alongside their head.
6. Roll the victim gently onto their back so that they face towards you during the roll.
7. Maintain this grip and move forwards (corkscrew), at the same time rolling the victim towards you until they are in a face-up position.
8. Determine if the victim is conscious or unconscious:
 - unconscious—call out for assistance, such as more lifesavers and a spinal board.
 - conscious—reassure the victim by explaining how you are going to extract them from the water.

Second responder (hip position)

9. Support the victim's hips with both hands.
10. Slowly raise the hips in line with the surface of the water.
11. Signal for 'assistance required' to attract more lifesavers to assist with the spinal board carry.

Note: Alternatively, you can stabilise the victim's head in water and maintain their airway by using the vice grip roll-over technique when you are in sufficiently deep water to be able to fully submerge underneath the victim. Follow the below steps to perform a vice grip roll-over:

1. Adopt vice grip:
 - a. Clasp the back of the victim's head with one hand and position the forearm so that it is lying against the victim's spine – take care not to push the head forward
 - b. Grip the victim's jaw with the other hand and position the forearm down the victim's chest
 - c. Squeeze the forearms together to create a vice that supports the neck and head.
2. Move under the victim and roll the victim into a face up position while maintaining the vice grip
And taking care not to raise the victim out of the water; this may cause movement of the spine.
3. Move forward to create a corkscrew effect to keep the roll smooth as the victim is turned and you end up on the opposite side of the victim
4. Stabilise the victim on their back and monitor.

Care must be taken to ensure that pressure is not applied to the soft tissue part of the neck and that the victim's head is not pushed backwards out of the neutral position.



Adopting vice grip



Moving under the victim while maintaining vice grip



Vice grip end result

Part 2—Spinal board carry

After stabilising the victim's head, and while reassuring the victim if conscious, a spinal board (or rescue board if no spinal board is available) can be moved into place under the victim to support their spine and transport them back to shore. SLSA recommends that a minimum of five lifesavers perform this procedure when possible. The lifesaver taking the role of first responder will not grasp the board at any point during the procedure as they continue to stabilise the victim's head.

Responder with spinal board

1. Align the spinal board along the victim's side opposite the lifesaver who is supporting the victim's hips (in the hip position).
2. Submerge the spinal board under the victim by placing it vertically on its edge before pushing it down strongly into the water.
3. Guide the spinal board so that it floats into position under the victim. Other responders except the first responder can assist you with this as they arrive and take their team position.
4. Inform the lifesaver supporting the victim's hips that they can release their hold when the spinal board is in place, so the victim is in contact with the spinal board.
5. Without losing contact of the spinal board and while the team leader maintains control of the victim's head, the extraction team will need to position themselves around the spinal board for best weight distribution, facing the direction they intend to walk as follows:
 - victim left shoulder
 - victim right shoulder
 - victim left knee
 - victim right knee.
6. Grasp the spinal board beside you using the closest handle.
7. Lift the victim simultaneously to a position above water level when instructed by the head position (team leader).
8. Walk as a team and at the same slow pace towards the shore while following any further instructions from the head position. The head position always walks forward to avoid tripping and does not turn their body to maintain stabilisation of the victim's head.
9. Continue to walk up the beach beyond the high tide line once at shore.
10. Slowly lower the victim while simultaneously dropping to a one-knee position when instructed by the head position.
11. Slowly lower the victim while simultaneously dropping to a kneeling position when instructed by the head position.
12. Slowly lower the victim simultaneously to the ground when instructed by the head position.
13. Lower the victim's arms so that they are in a more comfortable position and less likely to move. The head position continues to maintain stabilisation of the victim's head.
14. Manage the victim's airway and provide spinal care.

Responding to waves

The first responder in the head position should always have their back to the surf to protect the victim from oncoming waves. They will instruct at least one responder to alert of oncoming waves and provide warnings and advice on movement. When responding to waves:

- stop and stabilise the victim then brace yourself before a wave or white water hits the rescue team
- where possible, all responders should simultaneously lift the spinal board, so the victim's head remains out of water
- ensure the victim is secure after any wave before continuing to walk as a team towards the shore when instructed by the head position/team leader.



Note:

- Avoid tripping by not crossing your legs as you carry a victim on a spinal board.
- All responders should keep their backs straight and practise safe manual handling when lifting and lowering a victim using a spinal board (See [Manual handling](#)).
- The first responder (head position/team leader) continues to maintain stabilisation of the victim's head while the victim is lowered to the ground and other responders manage the victim's airway.
- The first responder may need to be relieved of their head position after the victim is lowered to the ground. This should be done with minimal movement of the victim's head and neck.
- Team positions may change throughout the process.

Managing the spinal victim's airway

Managing the victim's airway takes priority over suspected spinal injuries.

- **When in the aquatic environment**—this is achieved by using the extended-arm roll over technique.
- **When on land**—it is acceptable to gently move the head into a neutral position if the airway is blocked. In victims needing airway management, jaw thrust and chin lift should be used to minimise neck movement.

Lifesavers qualified in advanced resuscitation may administer oxygen.

Providing spinal care

All victims with a suspected spinal injury require ambulance assessment. You will need to provide spinal care while waiting for the ambulance to arrive.

Unconscious victims

An unresponsive, breathing victim with a suspected spinal injury should be placed in the lateral position, to maintain an adequate airway. The victim should be:

- turned onto their side using the log roll technique (See [Log roll technique](#))
- handled gently, with no twisting or forward movement of the head and spine
- rolled with spinal alignment maintained and the head in a neutral position
- kept warm and continuously monitored.

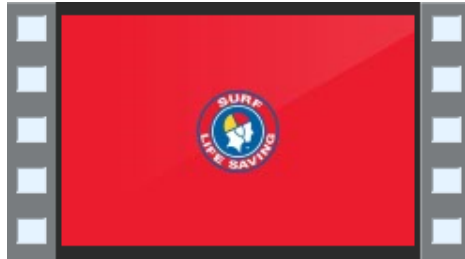
An unconscious victim may present themselves lying down in a face-up (supine) or face-down (prone) position. Maintain spinal alignment of the head, neck and torso at all times.

Conscious victims

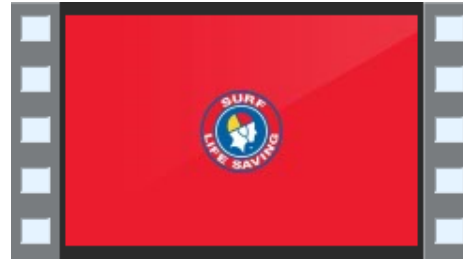
A conscious victim may walk up to you or present themselves lying down.

Walk up victim—It is common for victims with a possible spinal injury to walk up to lifesavers on duty and complain of neck pain following a collision with a sandbank or from beach activity. Where the victim approaches the lifesaver on foot, the victim should be instructed to lower themselves carefully to the ground while keeping their head still.

If the victim has difficulty lowering themselves to the ground, they may be supported by two lifesavers each taking a victim's upper arm as they assist the victim lowering to the ground. Once the victim is lying face up on the ground, the first responder on patrol should then ensure the manual immobilisation of the victim's head and neck in the neutral position.



Video - Spinal walk up - assisted to ground



Video - Spinal walk up - Lowers themselves

Victim lying down and face up—A conscious victim with suspected spinal injury who is found on land lying face upwards should be left where they are found unless movement is necessary to extract them from danger. If the victim can be safely left where they are found, manually stabilise their head while keeping them warm, monitoring their condition and reassuring the victim until medical help arrives.

If the victim starts to regurgitate/vomit, immediately roll the victim into the lateral position using the log roll technique and recommence primary assessment.

A conscious victim lying face down should be log rolled onto their back if their airway requires management. A log roll (see next section) should be used whilst stabilising the victim's head and neck in a neutral position, taking care to ensure spinal alignment during the roll. Unconscious victims should be log rolled into the lateral position and a primary assessment commenced.

Victim lying down on a spinal board— Victims do not need to be routinely placed on a spinal board unless they need to be extracted from danger. Where a victim with suspected spinal injury has been moved onto a spinal board (for example after removal from the water) and placed on the ground, they must be removed from the spinal board using the log roll technique. They should not be routinely left on the board for any extended period of time.

Spinal care for children and infants

When treating a victim younger than 8 years old, the anatomical differences between child and adult victims must be considered. The younger child or infant has a relatively large head in proportion to its body. In the supine position (lying face up) the enlarged head can be pushed forward into a hyper-flexed position, thus narrowing the airway and elongating the cervical section of the spine. In cases of suspected spinal injury in children, the placement of padding under the child or infant's torso (shoulder to hip) will assist in aligning the victim's head in the neutral position.

Log roll technique



The log roll is an accepted method to:

- facilitate airway management in an unconscious spinal victim
- facilitate clearance of a spinal victims' blocked airway.
- facilitate the patient who is vomiting or regurgitating.
- turn a victim onto their side to allow for the placement or removal of a spinal board.

A log roll is best performed using four to six lifesavers; however modified versions using two or three lifesavers can still be successfully performed. When performing a log roll, the victim's arms are positioned down each side of their torso with their hands against their body. Their head, trunk and toes should always be kept in a straight line during the manoeuvre.

Follow these steps to perform a log roll as part of a team of four lifesavers:

Lifesaver	1 (Team leader)	2	3	4
Position	At the top of the victim's head	Beside the victim's chest	Beside the victim's pelvis	Near the victim's head
Position details	Manually stabilise the victim's head with both hands using a trapezius grip.	Reach across the victim; securely grasp their shoulder and upper to mid-thigh.	Reach across the victim and securely grasp their upper arm and mid-to-lower thigh (this may vary depending on the size of the victim). They can also secure the victim's legs by grasping both ankles.	Prepare to clear the victim's airway and place or remove the spinal board when appropriate.

Table 1 – Steps to perform a log roll

1. Lifesavers 1–4 position themselves for the roll.
2. Lifesaver 1 positioned at the head coordinates rolling the victim into the lateral or recovery position, e.g., 'three, two, one, roll.'
3. Lifesavers 1–3 simultaneously and slowly roll the victim towards themselves while ensuring the victim's head, trunk and toes are kept in a straight line during the roll.
4. Lifesaver 4 treats the victim as required, e.g., clears the victim's airway, removes or places the spinal board.
5. Lifesaver 1 positioned at the head coordinates rolling the victim into the supine position when appropriate, e.g., 'Three, two, one, roll.'
6. Lifesavers 1–3 simultaneously and slowly roll the victim away from themselves while ensuring that head and spine stability is maintained at all times.

Strapping and Extrication

Strapping



A spinal board placed under the victim can be used by first responders should it be necessary to extricate the person. Strapping should be used to adequately immobilise the victim prior to moving. There are a variety of different straps that may be used. You should familiarise yourself with the ones used at your club.

To stabilise the victim for extrication, immobilisation strapping should be fitted over the victim's body and secured to the spinal board (see image above). Medical guidelines generally advise that the chest strap should be secured first, followed by the hip and foot strap. As a precaution, first responders should always check the strapping manufacturer's instructions about how straps should be applied).

Once all straps have been fitted, the first responder should check the security of the victim and adjust the straps as required. First responders must maintain spinal alignment and head immobilisation until victim handover. Strapping has been shown to restrict breathing and should be loosened if compromising the victim. It is important that the first responder constantly reassures the victim and monitors for discomfort, breathing difficulties and vomiting. Strapping should only be applied if the victim is being extricated from danger to a location where medical personnel can assess them and should be removed immediately after extrication is complete.

Extricating a victim

Once the victim is secured to the spinal board, they are ready to be extricated.

1. The victim can be given oxygen therapy, if necessary
2. Plan a coordinated lift – the first responder positioned at the head of the victim is in charge of the lift/movement
3. Use safe lifting practices, maintaining head stabilisation
4. Extricate victim to desired location, feet first, maintaining head stabilisation and ensuring that the board stays level
5. Continue to monitor victim's condition.

Points to remember:

- avoid lifting one end of the board higher than the other – keep the board horizontal, or the head higher on stairs or on an incline
- do not slide the spinal board across the ground or surface; it may catch and jolt the victim
- ensure that hair, jewellery and clothing is clear and cannot catch against surfaces or become caught in the first responders' hands, straps, etc.
- use safe lifting practices and lift in a coordinated manner
- carrying the victim feet first allows the first responder supporting the head to walk in a forward direction.