

54 Spinal injury

54.1 Introduction

The spine is protection for the all-important spinal cord, and the nerves arising from it. Your main responsibility is:

- (1) *Not to make patients with spinal injuries worse unnecessarily.*
- (2) To recognize stable fractures of the cervical spine and immobilize them.
- (3) To apply neck traction to the occasional patient who has an unstable cervical spine fracture, without neurological deficit.
- (4) To give good treatment for all injuries of the thoracic and lumbar spine.
- (5) To care assiduously for paraplegics.

Unfortunately, there is little you or anyone else can do for a totally quadriplegic patient to recover neurologic function (54.13). Operations on spinal injuries are not indicated in a district hospital, and for only a few in a referral hospital. *Any manipulation of the spine, whether under GA or not, is very dangerous, even in the hands of experts.*

A common error is to fail to fit a collar when needed.

The only special equipment you need are Gardner Wells tongs, or Hoen's traction using a brace and burrs.

These expensive tongs are the most practical way of applying traction to an unstable cervical spine fracture. The alternative, Crutchfield tongs are less satisfactory, but are easy to apply and will hold for about 6wks.

Alternatively, you can make a halo (54-12). It is best if these halos are made centrally and distributed to district hospitals so that you have one when you need it, as there will not be time to make one in an emergency.

54.2 Syndromes of spinal injury

The spinal cord, the soft tissues, and the bones of the may all be damaged by compression, shearing, or hinge forces, as well as by missiles. Occasionally, in a hyperextension injury, the vertebrae subluxate momentarily and then return to their normal position, so that a severe cord lesion may be combined with a normal radiographic appearance, especially in the neck.

The opposite is also true, and a gross spinal bony injury may leave the spinal cord intact. Fortunately, most spinal injuries don't damage the spinal cord.

If the cord is affected, this dominates the treatment, and prognosis.

A spinal injury may be stable or unstable. In the latter, the spine cannot sufficiently protect the cord from bony or ligamentous displacement that arises in normal movement.

Act safely and assume that: (1) any spinal injury is unstable, until proved otherwise, and (2) make sure that a patient is moved only by keeping the spine rigid. *This is of the utmost importance!*

N.B. Many a vehicle accident victim with an intact spinal cord has been pulled out of a wreck carelessly (without protecting the spine) and made para- or quadri-plegic! Any wrong movement might prevent the recovery that would otherwise have followed!

ALL SPINAL INJURIES ARE UNSTABLE UNTIL PROVED OTHERWISE

REMOVING A HELMET

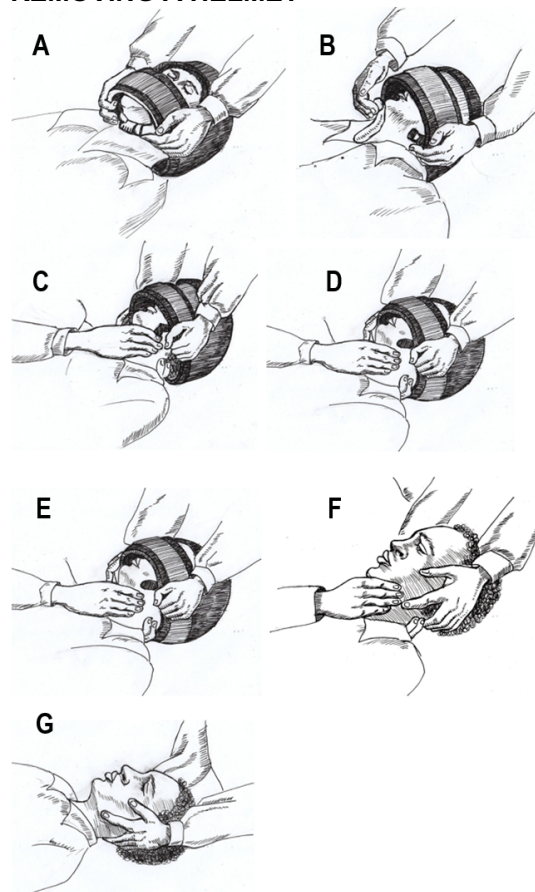


Fig. 54-1 REMOVING A HELMET. *If you don't do this properly, you can aggravate a cervical spine injury after a motorcycle accident. Find an assistant. A, apply traction in the line of the cervical spine. B, loosen the straps while maintaining traction. C, ask an assistant to hold the neck and exert traction. D, remove the helmet. (It is egg shaped, so expand it to clear the ears). E, get your assistant to keep the head still. F, take over traction from your assistant. G, continue to exert traction until you can support the head properly (54-5). Kindly contributed by Nancy Caroline.*

Serious spinal injuries can harm: (1) the spinal cord tissue, (2) the tracts within it, & (3) the nerve roots. Some or all of these can be injured, either completely or partly, at any level.

The critical diagnostic steps are: (1) to find the sensory level (to pinprick) and the motor level, (2) to find the bony level of the damage, and then (3) to compare these.

If the bony level is below the sensory level, look more superiorly. You have probably missed a 2nd injury there.

THE DERMATOMES

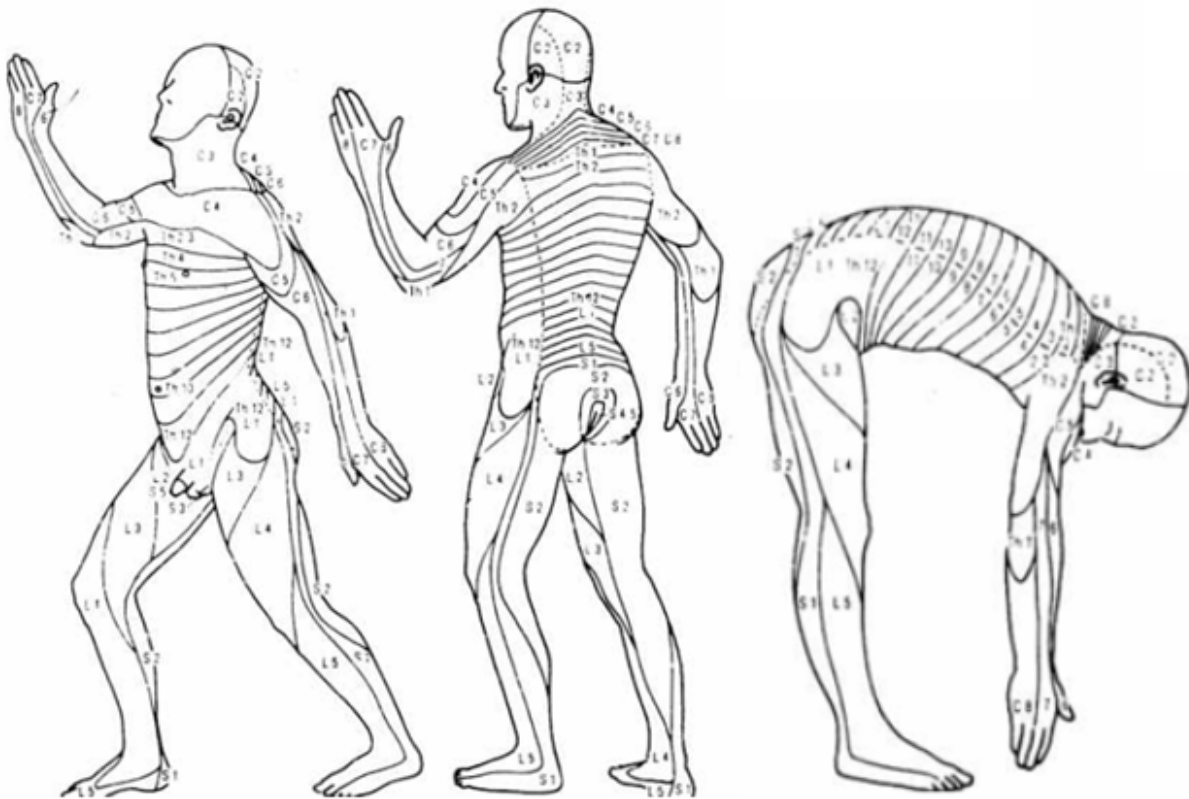


Fig. 54-2 THE DERMATATOMES. In a paraplegic, test the sensation with a pin from below upwards and use this chart to find the neurological level of the lesion. After Netter FH, CIBA collection of medical illustrations. with kind permission.

The further inferior an injury is the better the chances for walking, but the worse the outlook for bladder control.

A complete cord injury remains so. There is immediate flaccid paralysis in the lower part of the body, with no sensation whatsoever.

If the anal or penile reflexes remain despite para- or quadriplegia, it is further indication that the cord transection is complete and recovery is unlikely.

Later, reflex activity of the bladder and bowel reflexes return. The knee & ankle jerks recover and then become exaggerated; the muscles become spastic.

If bladder or bowel reflexes return without any sensation or motor power, this is an almost certain sign that the cord injury is complete.

INJURIES ABOVE C3

These injuries paralyse all respiratory muscles (intercostals & diaphragm) completely and often result in death before admission to hospital. There is also quadriplegia.

INJURIES ABOVE C5

Lesions above C5 cause quadriplegia. Below, it causes quadriparesis. A common site of injury is at C5–C6. This paralyse the hands, the intercostal muscles, and partly paralyse the diaphragm.

INJURIES ABOVE T10

Here, the important injury is the complete or incomplete division of the tracts within the spinal cord, destroying sensation and causing an upper motor type of paralysis.

Great force is needed to fracture the thoracic spine, so that the cord inside it is either normal, or completely transected.

INJURIES AT T10-L1 (54-3)

These are more often incomplete, and some sensation and muscular power usually returns slowly over many months.

An adult's first lumbar segment is at the level of the 10th thoracic vertebra, and the end of the cord is at the lower border of the 1st lumbar vertebra. Trauma here can injure the nerve cells of the lumbar enlargement or the nerve roots of the cauda equina, or both. A severe fracture with marked displacement will sever the conus and the spinal nerve roots down to T10, so that the fracture and dermatome levels are not the same.

LEVELS OF SPINAL INJURY

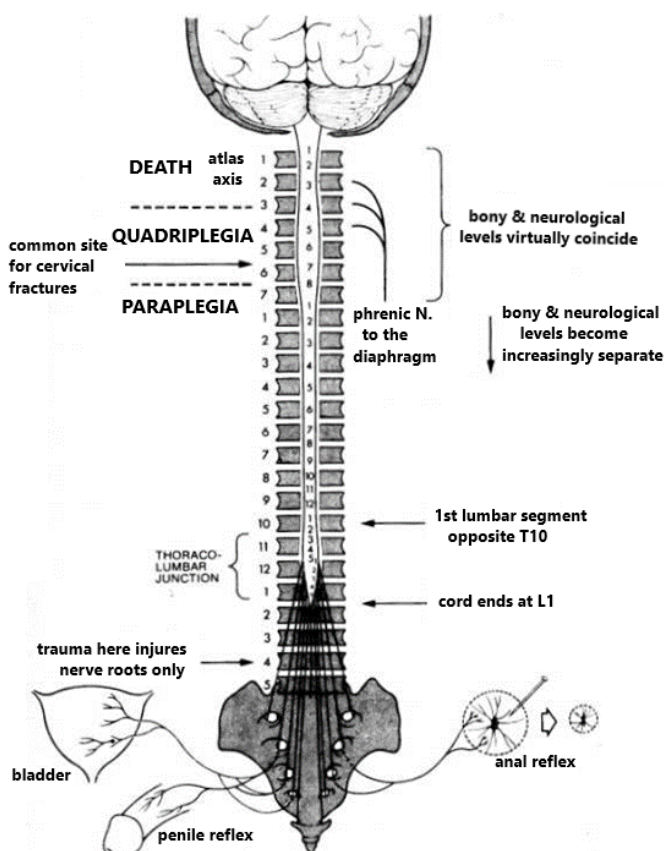


Fig. 54-3 LEVELS OF SPINAL INJURY. Note that the cord ends opposite the T12-L1 vertebrae. A fracture dislocation here causes a neurological lesion at this level—unless some roots escape injury.

DOES THE PATIENT HAVE MORE THAN ONE SPINAL INJURY?

Occasionally (especially at T12-L1) the nerve roots escape and only the conus is injured (known as 'root escape'). This makes the lower sacral segments anaesthetic (saddle anaesthesia) and destroys the central bladder reflex. It may however spare just enough of the nerve roots supplying the legs to allow walking. Pain suggests a root rather than a cord injury.

INJURIES BELOW L1

Trauma here may only injure the lumbar and sacral nerve roots of the cauda equina. If they have only been bruised they recover slowly, and the prognosis is good.

If the roots have been divided, they isolate the bladder from the reflex centre in the cord and bladder control is less satisfactory than it would be if the cord had been severed higher up.

The paralysed legs remain permanently flaccid.

54.3 Caring for a spinal injury

Spinal injuries are often missed for 2 reasons:

(1) An injured patient may be unable to say that he has lost the feeling in part of the body. The other injuries may be so much more visible than the fractured spine that, unless you routinely exclude a spinal injury in all severely injured patients, you will easily miss one.

A routine check is very quick: check movement of the legs? If you pinch one, does it move? If there is no movement of the arms nor legs, the cord is almost certainly injured.

(2) A patient with an unstable injury of the cervical spine may walk into hospital after a seemingly minor injury.

Immediately fit him with a soft collar and X-ray the neck. There may only be a minor soft tissue injury, or there may be an unstable fracture in danger of causing instant paralysis.

A spinal injury is terrifying for a patient because he may be completely paralysed and yet fully conscious. The prognosis and management are determined by the following facts:

(1) **If the injury is severe enough to cause immediate total paraplegia, or quadriplegia,** the spinal cord is almost certainly damaged beyond repair, and no treatment, surgical or otherwise, is going to make it recover.

(2) **If any function remains immediately after the injury,** the prognosis is completely unpredictable. There may be substantial recovery or none at all. So you must test if any function still remains.

(3) **If there are signs of recovery during the 1st few days,** the outlook is much better. The earlier and the more rapid the early recovery is, the more hope there is.

REFERRAL

Compare the care you can give with that likely in the referral hospital (1.8). Your care may be better: there is much greater need of devoted nursing than skilled surgery.

There is seldom any advantage in referring a patient with a serious spinal injury immediately, because you can probably do as much for him, or more, than a referral hospital. Injured nerve cells cannot regenerate, so there is little to be gained by trying to decompress the spine in the hope that they will regenerate. Immediate laminectomy may do more harm than good. Some weeks later an operation to fuse an unstable spine may occasionally be useful. The only procedure that is practical in the acute phase is cervical traction. Although this needs only simple equipment, it needs great skill.

MOVING A PATIENT WITH A SUSPECTED SPINAL INJURY

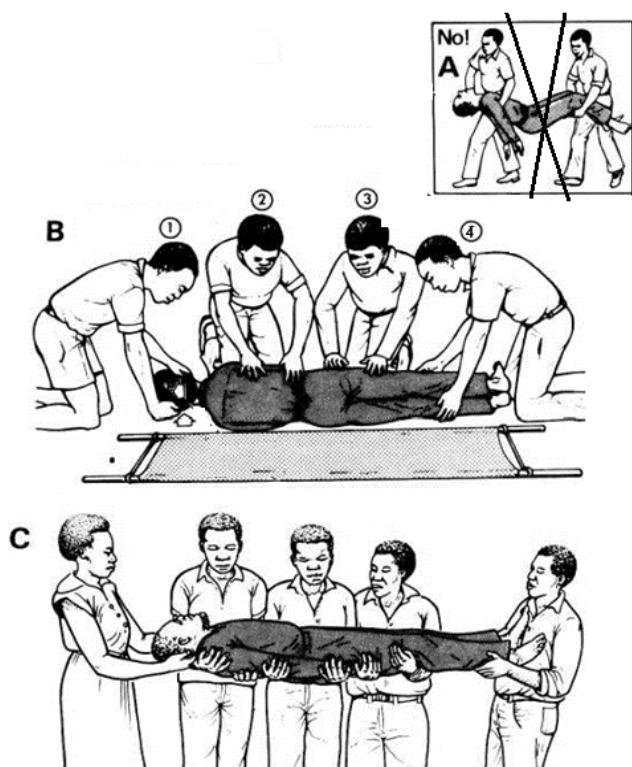


Fig. 54-4 MOVING A PATIENT WITH A SUSPECTED SPINAL INJURY. A, If you move a patient with a spinal injury incorrectly, you may convert a partial transection into a total one. B, note the number of people needed; exert gentle traction to the head while carrying the patient. It would be better for a cervical collar to be applied. C, Lifting the patient like a log; better to log-roll him onto a board. Kindly contributed by James Cairns.

N.B. Familiarize yourself with management of a severely injured patient (41.2,3)

MOVING AND UNDRESSING A PATIENT

To move or turn a spine injury patient you need 4 helpers. Move the whole body as a log. Minimize any movement of the spine, especially the neck. It is best to 'log roll' the patient from the ground onto a firm stretcher, or stretched blanket (54-4).

Fit a firm neck collar in place: You can improvise one with a rolled towel & safety pins (54-5C). *Do this before moving him!*

If you suspect that a neck injury, place one hand under the chin and the other under the occiput (54-5A), exert gentle traction on the neck, and lift and turn the head whilst the others turn the body: *don't let the head drop to one side.*

N.B. Holding the head is the task for the most skilled person in the team.

Steady the head with sandbags at its side, and a small roll under the neck (54-5B)

SUPPORTING AN INJURED CERVICAL SPINE

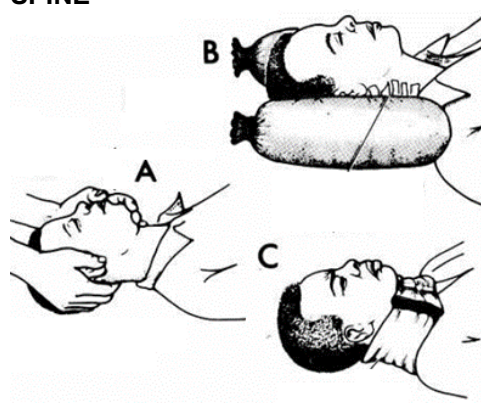


Fig. 54-5 SUPPORTING AN INJURED CERVICAL SPINE. A, holding the head is the task for the most skilled person in the team: one hand behind the neck and one on the chin. B, after rolling the patient onto the back, wedge the head between 2 sandbags. C, then fit a collar (improvise if necessary). After de Palma AF, *Management of Fractures & Dislocations, An Atlas*, WB Saunders 1970 with kind permission.

If you suspect a thoracic or lumbar spine injury, transport the patient prone with a pillow under the shoulders and pelvis to hyperextend the spine at the site of the injury, unless there are multiple injuries or the airway is in doubt. If so, retain the supine position.

HISTORY AND EXAMINATION

Leave the patient on the stretcher until you have examined him. Enquire carefully about the circumstances of the accident. This will tell you what type of injury to suspect. If conscious, ask where the pain is. A patient may be able to indicate that the body feels dead below a certain level. Signs of injury on the face and skull may help you to decide the kind of force responsible.

Look for:

- (1) Bruising, swelling, tenderness,
- (2) A disruption in the line of vertebral spines,
- (3) Any soft 'doughy' areas,
- (4) Movement in the legs,
- (5) Sensory loss on pinching.

DON'T FORGET TO EXAMINE THE BACK

Fig. 54-6 EXAMINING A SPINAL INJURY Feel for any local bruising, swelling, or tenderness along the spine. Examine the spinous processes systematically from neck to sacrum. Look for a disruption in the line of the spine. Feel for any soft 'doughy' areas. Test for movement & sensation in the feet. *Kindly contributed by Ronald Huckstep.*

Examine the spine: carefully slide your hand underneath the back, or, better turn him as a log with assistants (54-4A).

If the patient vomits and you need to turn him on your own, cross the right leg over the left, flex the left elbow to put the hand under the head, & then take the right shoulder and right hip and turn him gently towards you.

Feel for any local bruising, swelling, and tenderness along the spine. Examine the spinous processes systematically from the neck to the sacrum. Look for any disruption in the line. Feel for any soft 'doughy' areas between the spinous processes into which your fingers can sink. You may feel a palpable gap. These last two signs indicate an unstable fracture.

CAUTION! *Don't test the movements of the spine!*

Then make a directed neurological examination. This has 2 stages and if there is an associated head injury, interpreting either may be difficult.

Make a rapid test to check movement of equal strength in the legs, and reaction to pinching the skin.

If you suspect a spinal injury, test the sensation on the trunk with a pin, starting from below and working upwards. Find the sensory level, using the dermatome chart (54-3). Is there any recognition of foot or knee movement? Test the knee and ankle reflexes and the plantar responses. Prick the para-anal skin with a pin to test the anal reflex, which in the presence of paraparesis indicates 'sacral sparing'.

If there is severe continuous pain radiating from the neck to both occipital regions, suspect a fracture dislocation of the atlas on the axis.

N.B. Dislocations from C3-C5 cause quadriplegia. A C5-C6 dislocation produces a weak or paralyzed biceps. In a C6-C7 dislocation, the biceps is normal.

In dislocations above T1, Horner's syndrome (ptosis, a constricted pupil, anhydrosis on the affected side of the face, and enophthalmos) may be present.

N.B. Lumbar nerve roots supply:

- (1) leg sensation except the sacral segments,
- (2) hip & knee muscles,
- (3) cremasteric, knee & ankle reflexes,

Sacral nerve roots supply:

- (1) saddle sensation & a strip down the back of the leg and thigh,
- (2) ankle & foot muscles,
- (3) ankle, plantar, anal, cremasteric & penile reflexes, (squeezing on the glans causes the *bulbocavernosus* to react)
- (4) bladder control.

LUMBAR OR SACRAL PAIN SUGGESTS ROOT RATHER THAN A CORD INJURY

RADIOGRAPHS

Don't ask for an immediate image. Find the level of the neurological lesion first. It is possible to have leg problems but have an upper thoracic fracture! Examine the spine with care before deciding which part to X-ray. It is good policy to X-ray the entire spine routinely, if you have enough film, because fractures are often multiple. Position the patient onto an X-ray table yourself.

DECIDE IF THE FRACTURE IS UNSTABLE

N.B. 30% of patients have other severe injuries, particularly of the head (51.1) and abdomen (55.1), so look for them: this is critically important.

IMMEDIATE PROGNOSIS

If a patient is paralysed with a sharp line of anaesthesia, no reflexes, and no bladder control, with anal and penile reflexes present, the cord is probably transected completely.

Priapism (persistent painful erection of the penis) is another bad sign.

Firmly hyperextend the big toe. Test sensation in the toes, heels & perineum with a pin. If this is present despite paralysis, the cord function will recover.

24h PROGNOSIS

If at this time, there is still no perianal sensation, no voluntary control of the toe flexors, or anal sphincters, there is a 90% chance of having a permanent paralysis. If any responses are spared, or there is improvement in the first 48h, significant recovery is possible. But if there is no sign of improvement at 4 wks, (unless there is an overriding head injury) further recovery is very unlikely.

IMMEDIATE TREATMENT OF THE FRACTURED SPINE

(a) Cervical spine

Indications for neck traction:

- (1) any unstable fracture or any dislocation,
- (2) incomplete paralysis whatever the radiographic findings.

(b) Lumbar and sacral spine

Lie the patient in the most comfortable position.

INITIAL TREATMENT OF PARAPLEGIA & QUADRIPLEGIA

Immediately start 2hrly turning to prevent bed sores. These can develop in the 1st few hours after the accident only too easily. *Don't let the bladder fill up*; start intermittent sterile catheterization, if you have the staff and commitment to manage it (64.16).

For a quadriplegic, also pass a nasogastric tube to prevent aspiration. Supplement IV fluids to counter sympathetic vasodilation from transection of the cord. Watch for common abdominal distension and absent bowel sounds caused by ileus. On the 5th – 7th day administer an enema, or manually remove faeces.

A NORMAL NECK

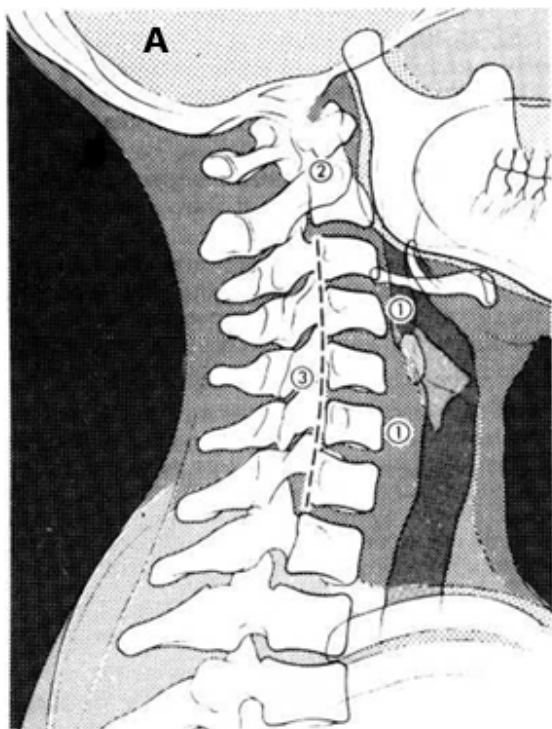


Fig. 54-7 A NORMAL CERVICAL SPINE. A, lateral view: (1) the normal soft tissue shadow in front of the cervical vertebrae. (2), the relation of the odontoid process to the rest of C2.

N.B. Transporting a cervical spine injury patient is never easy, eve by air. If the roads are bad, the journey long, and the quality of care at the other end uncertain, the patient will probably be better off with you, especially in the earlier stages. For transport, you need a rigid well-fitting cervical collar to travel as well and ensure that the neck must be kept straight, and not flexed, extended, or rotated.

NORMAL CERVICAL VERTEBRA

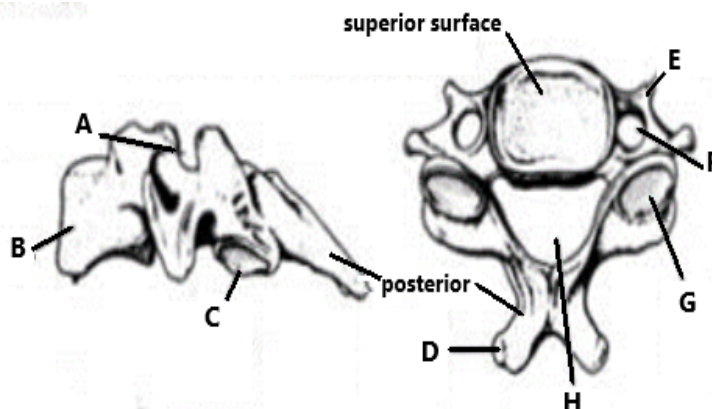
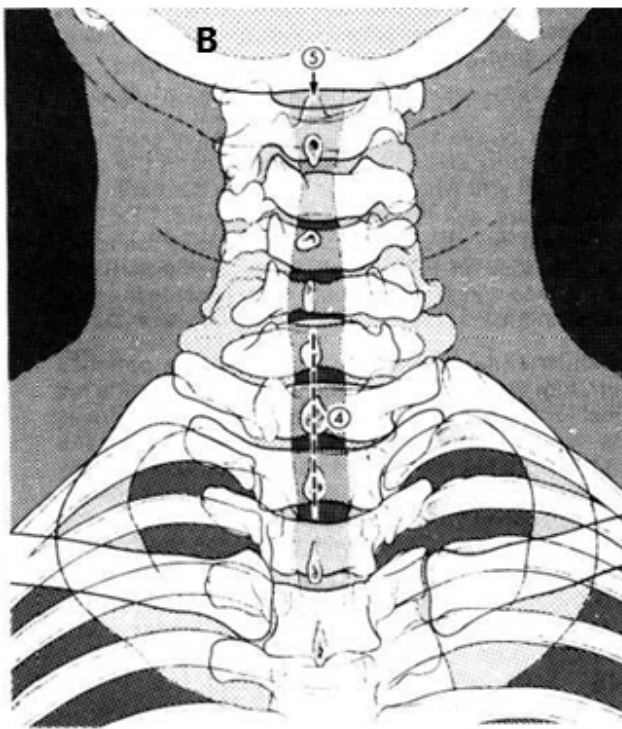


Fig. 54-8 NORMAL ANATOMY OF A CERVICAL VERTEBRA. A, superior vertebral notch. B, vertebral body. C, inferior articular surface. D, spinous process. E, anterior tubercle. F, foramen transversum (for the vertebral artery). G, superior articular facet. H, vertebral foramen- Kindly contributed by John Stewart & James Cairns.



(3), the posterior margins of the vertebral bodies form a smooth curve. B, AP view: (4), the spinous processes are in line. (5), the normal odontoid. Kindly contributed by John Stewart.

54.4 Interpreting the radiographs

You must decide if a neck injury is stable or not.

(1) Dislocations are always considered unstable, as are bending or twisting injuries of the posterior elements of the spine, which are what makes these injuries unstable. These include its pedicles, laminae, facets, and ligaments.

(2) Compression injuries of a vertebral body are usually stable. In a flexion injury, the posterior ligament is particularly liable to be ruptured, and in an extension injury, the anterior ligament.

Both types of injury can damage the intervertebral discs.

Radiographs should be good; those from a portable machine are usually useless. Even radiologists have difficulty interpreting radiographs of the spine, so you will probably have difficulty too.

The standard views in acute injuries are AP and lateral with the head in its normal position.

Finally, remember that a normal radiograph does not necessarily mean a normal spine.

N.B. Beware of any careless spinal movement & supervise the Xray assistant yourself!

Take one good AP view and two lateral views with the patient lying, one lateral view centred over the vertebral bodies at the site of maximal pain and tenderness, and another over the spinous processes at this level. Also take an open mouth (odontoid peg) view.

You must see the whole cervical spine, so make sure you pull the shoulders well down. Examine the vertebral bodies from top to bottom: they should have a normal box-like appearance.

Lesions at C6–C7 & C7–T1 are often missed. *Don't try to take oblique views*; they are difficult to take and interpret. If possible, take a 'swimmers (supine oblique) view'; this requires considerable experience and ability.

Count the vertebrae in the lateral view to make sure that you have not missed C7. If necessary, take another view with downward traction to the arms. You should see C7 and perhaps the upper border of T1. As always with difficult films, sit down and look at them on a viewing box, or with an electric light bulb, while you have no other distractions. Start at the extreme edges of the film, and work in towards the middle. It is quite common for the injury to be at the edge of the film.

UNSTABLE CERVICAL SPINE INJURY

In the AP view, look for:

- (1) Displaced vertebral bodies (54-9A)
- (2) Spinous processes out of line (54-9B)
- (3) Pedicles on either side of the spinal canal displaced laterally out of the line, compared with those above or below (54-9C)

In the lateral view, look for:

- (1) A multifragmented 'burst' fracture of the vertebral body (54-9D),
- (2) Vertebral body slipped forward (54-9E),
- (3) Unequal gaps between vertebral spines (54-9F),
- (4) Bases of spinous processes broken (54-9G),
- (5) Fractured articular facets (54-9H)
- (6) An abrupt change in the smoothness of the spinal curvature (54-14A)
- (7) An enlarged space between the back of the pharynx & front of the vertebral bodies (54-8A)

UNSTABLE SPINAL FRACTURES

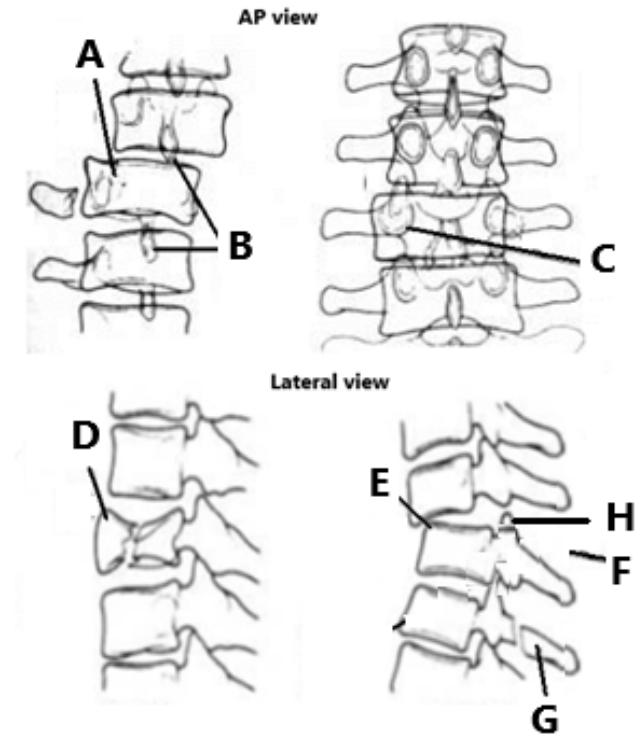


Fig. 54-9 UNSTABLE SPINAL FRACTURES. A, vertebral bodies displaced. B, spinous processes out of line. (A rotational injury can twist them out of line, especially in the cervical spine, even though the vertebral bodies themselves are still in line. C, Both pedicles displaced. (They are either both broken or not at all!). D, a burst fracture. E, one vertebra slipped forward, F, with unequal spaces between vertebral spines or, G, spinous processes broken at their base. (Usually with a ruptured posterior longitudinal ligament, perhaps with dislocation of the articular facets, or with fractures of the laminae and pedicles. The posterior intervertebral joints may have subluxed or dislocated on one or both sides. If displacement = $\frac{1}{2}$ x the vertebral body, one intervertebral joint has probably dislocated. This is seriously unstable, especially in the cervical spine.) H, fractured articular facets. *Kindly contributed by John Stewart & James Cairns.*

STABLE SPINAL FRACTURES

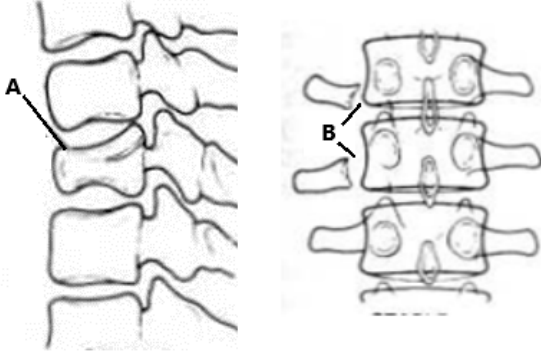


Fig. 54-10 STABLE SPINAL FRACTURES A, wedge fracture. B, transverse process fracture. Kindly contributed by John Stewart & James Cairns.

If the vertebral body is wedge shaped, this is a compression fracture, which is usually stable (54-10A).

Broken transverse processes of the lumbar vertebrae make no difference to the spine (54-10B), but suggest possible retroperitoneal injury, especially of the kidneys (55.15).

Fractures of the spinous and transverse processes are unimportant: they imply muscle injuries.

Look carefully at the base of the patient's odontoid, and at the arch of the atlas.

If you suspect a cord injury clinically but cannot see one in the films taken, take more films higher up the spine.

A NORMAL RADIOGRAPH DOES NOT NECESSARILY MEAN A STABLE SPINE

54.5 Management of cervical spine injury

UNSTABLE FRACTURE

You should treat all cervical injuries as unstable if:

- (1) the radiological signs (54-9) are suspect,
- (2) there are neurological signs (the only exception is an acute extension injury (54.8)).
- (3) there are signs of instability on clinical examination, such as:

(a) disruption of the smooth line of spinous processes from the neck to the sacrum,

(b) any soft doughy areas between the spinous processes into which your finger can sink. (This implies that the strong ligaments between the vertebral spines are ruptured.)

If there are (rarely) no neurological signs, put on a plaster neck cuirasse (54-11). Continue to monitor their neurological signs, as any slight cervical movement may be catastrophic. At the slightest evidence of a deficit, apply traction.

If there are neurological signs, the injury is unstable, even if radiographs look normal. Apply traction, even if you are uncertain about the instability.

If quadriplegia is complete, apply traction for 7 days only. There is no point in continuing beyond then because it will make nursing care more difficult.

N.B. Complete or partial recovery is more likely with cervical than with thoraco-lumbar injuries.

If there is a burst fracture & no neurological signs, apply traction for 6 wks, followed by a collar for 12 wks.

STABLE FRACTURE

These are generally wedge or transverse process fractures.

If there is pain but no neurological signs, fit a firm neck collar.

If there is an extension injury, with injury of the anterior longitudinal ligament, fit a collar for 2-3 months.

If there is no other reason for bed rest, encourage mobilization with the collar.

54.6 Neck collars & traction

An ambulant patient with an unstable or doubtfully stable cervical fracture needs protection against sudden sharp movements which might injure the cord. The choice is a collar or plaster neck cuirasse (54-11).

The rigid collar is a neck brace, which ideally immobilizes from the sternum to occiput and mandible.

N.B. A soft collar is inadequate!

You can distract an unstable cervical fracture satisfactorily with Crutchfield or Gardner Wells tongs.

N.B. A halo, which you can make locally, has a big problem in that it tends to slip off the head. A halter (effectively a strap round the chin and back of the head) is useful for temporary use only. There is not enough traction to reduce a dislocation, and it becomes very uncomfortable after a short while. If you apply too much traction with a halter for too long, it can cause pressure sores.

Traction is pointless for complete quadriplegia.
CUIRASSE

Apply a layer of stockinette and pad the bony points over the lower jaw, occiput, and clavicle. Apply a broad slab down the front of the neck from the chin to the upper sternum, and another down the back of the neck. Bind these slabs in place with circular plaster bandages. Let the cuirasse set with the chin up (54-11). Finally trim it to shape, turn over the edges of the stockinette and bind them in place.

A PLASTER NECK CUIRASSE

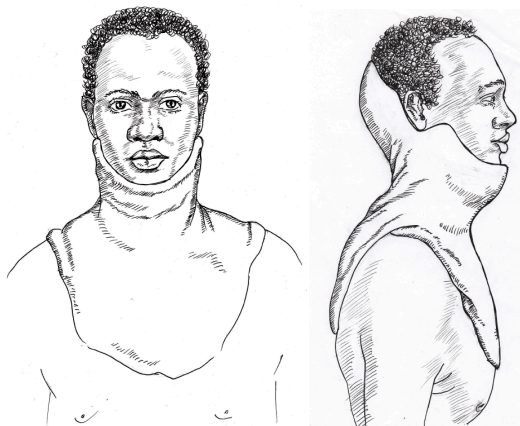


Fig. 54-11 A PLASTER NECK CUIRASSE.

Kindly contributed by John Stewart.

N.B. A Minerva cast (plaster down to the waist) has no real advantage over a neck cuirasse, and is far too hot to wear & a problem if there is cutaneous sensory loss.

SKELETAL NECK TRACTION

Use tongs for successful cervical traction.

Good nursing care is vital for successful cervical traction!

Apply only just enough weight to reduce the displacement. If you apply too much too suddenly, you may increase the soft tissue injury, and harm the cord.

CAUTION! (1) Monitor the neurological state carefully. (2) *Never apply more traction than the maximum indicated.* (3) If at any time there is deterioration in the neurological state, reduce the traction immediately. (4) If you are in doubt as to what to do, be safe and reduce the traction or take it down.

Apply traction on a bed with boards covered with ≥ 10 cm of foam rubber, and large castors. You should be able to adjust the height of the pulley vertically.

CAUTION! *Don't use traction unless you are able to take bedside radiographs!*

By applying traction, you aim to draw the cervical fragments apart with steadily increasing traction over some hrs, then to maintain traction with a smaller weight for several wks.

Then protect the neck within a firm collar or cuirasse for 8-12wks, for the spine to stabilize.

CERVICAL TRACTION WITH TONGS

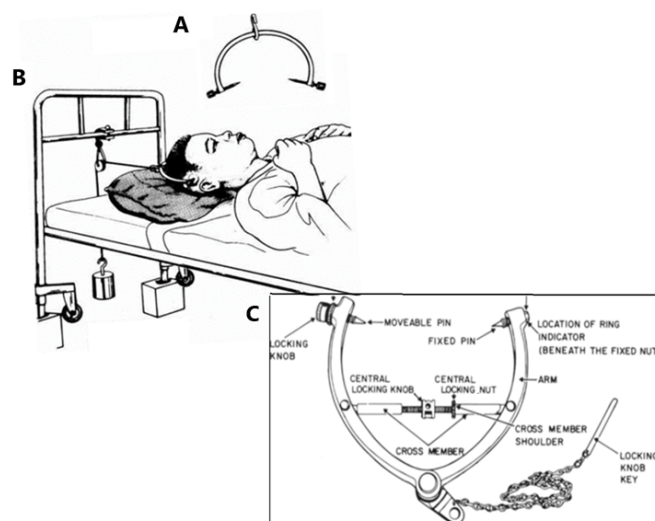


Fig. 54-12 CERVICAL TRACTION WITH TONGS. A, the Gardner Wells tongs. B, Crutchfield tongs C, for a fracture dislocation, apply only just enough weight to reduce the displacement. Note the blocks to raise the head of the bed. After de Palma AF, *Management of Fractures & Dislocations, An Atlas*, WB Saunders 1970 with kind permission. B, After Rinnel RW, Butler AB, Wilson HR et al. *Modified skull tongs for cervical traction*. *J Neurosurg* 1981; 55(5): 848-9.

APPLYING GARDNER WELLS TONGS FOR CERVICAL TRACTION (GRADE 2.3)

METHOD

Sedate the patient with diazepam. *Don't use GA.* Fit the tongs on the ward. *Don't shave the scalp.*

Disinfect the skin. Introduce some LA 2cm above the ears in the line of the mastoid processes, just caudal to its maximum diameter, right down to the periosteum.

Disinfect the points of the screws. One screw is spring loaded, so that as the tension is increased a small nipple protrudes. Twist the screws so that their points go through the anaesthetized skin, & grip the outer table of the skull. Tighten them until the small nipple in one of the screws protrudes 1mm, then tighten the locking nut.

HOW MUCH TRACTION?

This depends on the build of the patient, the position of the injury and whether you are reducing a dislocation or maintaining traction:

| C1 | C2 | C3 | C4 | C5-7 |
|---------|-------|-------|--------|--------|
| 2.5-5kg | 3-5kg | 4-7kg | 5-10kg | 7-15kg |

Apply the weights over a pulley. Raise the head of the bed c.4cm/kg.

Apply traction in a straight line, avoid flexion, extension or, rotation. For a C4/5 lesion, e.g., start with 7kg. Cautiously add 2kg every 15mins, checking constantly for neurological changes. When you have applied 15kg for 30 mins, get a radiograph.

REDUCING A FRACTURE DISLOCATION

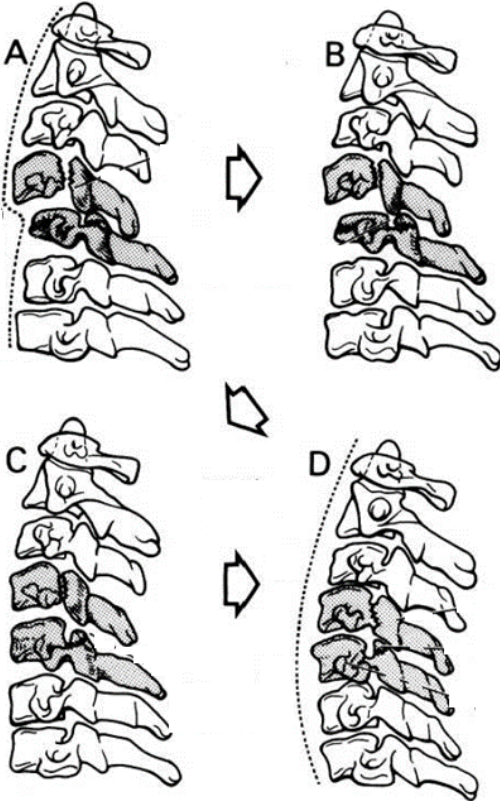


Fig. 54-14 REDUCING A FRACTURE DISLOCATION. A, before applying traction: the anterior curve is kinked. B, disengagement starting. C, disengagement complete. D, the smooth anterior spinal restored. *N.B. Unfortunately, reduction is rarely as easy as it looks here, and often fails.* After de Palma AF, *Management of Fractures & Dislocations, An Atlas*, WB Saunders 1970 with kind permission.

The facets may begin to disengage (54-14B), but you may have to wait longer.

If there is no disengagement, leave the 15kg traction for a maximum of 48h, taking radiographs at 6, 12, 24h.

As soon as the articular processes are completely disengaged, the overriding is corrected, and the distance between the fragments of the pedicles is narrowed, reduce the weights, keeping the neck in a straight line. Usually, the facets will come into line.

At 2-3wks, you can reduce traction to 3-5kg. Get weekly lateral check radiographs for the first month, or after altering the weights.

At 6wks, replace traction by a cuirasse or a collar (54.6).

Leave this on for another 6wks. Then remove the cuirasse or collar. Get AP & lateral radiographs.

NURSING

Turn the patient 2hrly: left side, supine, right side. Alternate periods in which turning is completely left & right with periods in which turning is partly left & right. Take great care to move the head 'in one piece' with the rest of the body. You will need 3 nurses while you do this, with you to look after the head and neck.

At 6wks, when you replace traction with a cervical collar, add the prone position during turning. Rub the pressure areas 2hrly.

If the vertebrae show no signs of slipping in normal or in flexion or extension views, advise a gradual increase in the movements of the neck but to avoid sudden movements, & to restrict outdoor activities.

If the neck is still painful & unstable after 12wks, (i.e 6 in traction & 6 in a collar or cuirasse), cervical spine fusion may be needed.

If the injury is mainly bony, the fragments will eventually fuse and the injury will become stable.

If the injury is mainly ligamentous, you may not achieve stable union. A collar is necessary for up to a year in case late displacement occurs.

DIFFICULTIES WITH CERVICAL TRACTION

If you have made the diagnosis late, the fracture may not be stable. Fit a collar for 12wks. *If this does not relieve symptoms in 2wks*, apply traction for 2wks more and then replace the collar.

If a patient with a recent cervical injury has other serious injuries which make cervical traction impossible, fit a cervical collar.

If a fracture redisplaces, immediately when traction is reduced, or later, or if a dislocation of the articular facets recurs, reapply traction, especially if nerve root symptoms recur. Apply more weight ($\leq 17\text{kg}$). The danger of quadriplegia is great, so refer him if you can.

54.7 Atlas (C1) & axis (C2) fracture

Some injuries of the 1st 2 cervical vertebrae are instantly fatal. If a patient survives, there is often a stiff painful neck following a head injury. The patient supports the head in the hands and has difficulty turning it, and may say the head feels wobbly. Although there may be no neurological symptoms, if the neck is jerked suddenly, there is danger of sudden paralysis. There may be a fracture of the atlas, or the odontoid process of the axis.

The atlas is seldom injured, except by impact on the top or back of the skull (e.g. in a fall, road accident or diving injury, or by a child against playground equipment), or in severe hyperextension. Analgesia is the only requirement, with immobilization in a soft collar and bed rest for comfort.

If there are neurological signs (e.g. Horner's syndrome or ataxia) a firm collar or even traction is better.

The odontoid process of the axis is its most vulnerable part, and is usually injured by a direct blow to the front of the skull, which hyperextends the neck, e.g. in a fall, or a head-on car crash. As the skull moves backwards, it carries the atlas and the odontoid process backwards also. Either the odontoid process fractures, or, more seriously, the retaining transverse ligament tears and allows the odontoid to press on the cord and kill the victim instantly. If he survives, the injury is probably stable enough to be treated in a cuirasse until there is bony or firm fibrous union.

Radiographs of most fractures of the upper cervical region are difficult to interpret. You should, however, be able to recognize an odontoid fracture. If in doubt, always fit a collar.

RADIOGRAPHS

You need special views. If the films are bad, try again. *You cannot make the diagnosis from poor films.*

Take an AP view through the open mouth to avoid the teeth. Place a cork between the rear teeth to hold them open. Place the head in moderate extension, so that the edge of the upper teeth falls in line with the base of the skull as it joins the cervical vertebrae.

Look for a crack through the odontoid peg, or a step at its base. The odontoid ossifies from a separate centre, so in a young person *don't interpret the normal growth line as a fracture.*

N.B. This growth line sometimes persists into adult life.

FRACTURES OF THE ATLAS & AXIS

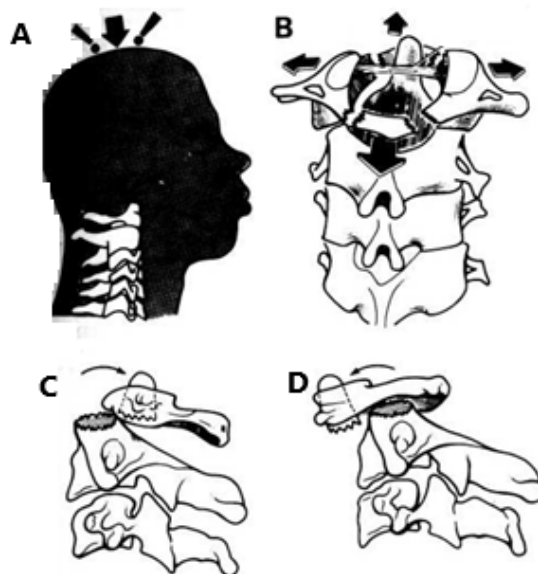


Fig. 54-15 FRACTURES OF ATLAS & AXIS. A, trauma to the vertex. B, AP view: posterior odontoid displacement. C, lateral view: posterior odontoid displacement. D, lateral view: anterior displacement with posterior arch fracture. Adapted from de Palma AF, *Management of Fractures & Dislocations; An Atlas*, Saunders 1970 with kind permission.

If the lateral masses of the atlas are spread significantly, there is a burst fracture, which has torn the transverse ligament.

Focus the tube on the lobe of the ear which overlies the odontoid. A visible prominence of the soft tissues at the back of the pharynx suggest an injury to the cervical spine.

ODONTOID PEG FRACTURE

Use traction as for other fractures and dislocations of the cervical spine. Even if there is no neurological defect, it gives better stability and prevents backward displacement and angulation.

BURST ATLAS RING FRACTURE

The ring bursts at its weakest point where its posterior and lateral masses join. This is the Jefferson fracture; the classical 'hangman's' fracture is of the C2 pedicle, although in hanging, death is generally by strangulation.

N.B. Radiographs of C2 are particularly difficult to interpret.

Fit a collar.

IF AN INJURED PATIENT IS SITTING UP HOLDING THE NECK, FIT A COLLAR

FOLLOW UP THE PATIENT CAREFULLY

54.8 Cervical hyperextension injury ('Porter's neck')

Where people carry large loads on their heads, this is quite a common injury. The patient, who is usually a woman, stumbles and falls. The heavy load falls backwards and extends or rotates her head violently. On arrival, she is usually found to have a quadriplegia. Fortunately, the cord is not often, injured, and even if it is, there is some hope of recovery.

HYPEREXTENSION INJURY (PORTER'S NECK)



Fig. 54-16 HYPEREXTENSION INJURY A heavy load falls from the head when the person carrying it stumbles. Hyperextension or rotation causes a transient quadriplegia. Radiographs are usually normal. Kindly contributed by John Stewart.

Radiographs may show no fracture. The likely narrowing of the cervical disc spaces together with osteophytic overgrowth are not responsible for the symptoms, which are due to a sudden infolding of the *ligamentum flavum* pressing on the cord. The prognosis is usually good. Fit a soft collar, and care for the quadriplegia until it recovers.

Another variety of cervical hyperextension is the 'Whiplash' injury, caused by sudden hyperextension followed by hyperflexion, as in a head-on collision. The cervical spine is distorted into an S-shape with the lower part in kyphosis and the upper part in lordosis.

Typically pain & stiffness in the neck comes on some days after the event. Radiographs show no fracture. Active early mobilization gives better results than a soft collar.

54.9 Torticollis (Wry neck)

(a) At birth

This is the end result of the birth injury known as 'Sternomastoid tumour', which is a haematoma into the *sternomastoid* muscle. Make every effort to try to turn the baby's head the opposite way to the deformity. For example, if the head turns to the right, have him nursed on the left.

If the condition lasts >2 months, refer the baby for lengthening of the sternomastoid.

TORTICOLLIS



Fig. 54-17 TORTICOLLIS Spasm of the sternomastoid causes the neck to remain flexed sideways. Kindly contributed by John Stewart.

(b) In older children

Torticollis can follow a variety of neck or throat infections, such as peritonsillar abscesses, or it can follow an injury.

If the distance between the odontoid peg and the back of the anterior axis (C1) is >3mm in adults or >4.5mm in children, the transverse ligament has been stretched and the ring of the atlas has slipped forward.

Atlanto-axial subluxation is serious, because paraplegia may follow, and because the torticollis may last weeks, or occasionally permanently, if you don't treat it.

The differential diagnosis includes TB, but here collapse is much more usual than subluxation.

(c) In young or middle-aged adults

This may present with gradually increasing neck pain & inability to turn the head, holding it twisted and flexed to one side. This may come on after injury, vigorous exercise or sleep, but may be spontaneous.

EXAMINATION

Spasm in the neck muscles may be visible. Look for a 'trigger point' which causes the patient to wince (*don't overdo this!*).

Test for any neurological deficit (especially after trauma), and if so, obtain cervical spine radiographs (54-8,9,10). Ask if there is dysphagia. Very occasionally an unusual disc herniation may cause a torticollis.

Look for signs of infection (fever, lymphadenopathy, tonsillitis, pharyngitis, trismus)

MANAGEMENT

If there are no other signs but trigger points inject these with 5mL 0.5% bupivocaine + 20mg prednisolone.

N.B. This may cause initial exacerbation of pain before relief!

N.B. Don't allow violent manipulations of the neck!

N.B. Don't confuse torticollis with a dystonic reaction to chlorpromazine or haloperidol!

54.10 Thoracic & lumbar spine fracture

The spinal cord ends at L1. A patient with a fracture at or above this level is usually either grossly injured and paraplegic, or has a stable fracture. Below this level it is possible to have an unstable fracture and a normal cauda equina.

If there is no cord injury, you can easily miss these fractures, especially if there are severe injuries elsewhere, or also, unconsciousness.

The spine can be injured by a force which compresses or flexes it, usually at:

- (1) T7–T8, the apex of the thoracic kyphosis,
- (2) T12–L1, the thoraco-lumbar junction, or
- (3) L4–L5.

The result can be a fracture dislocation (54-9A) a burst fracture (54-9D), or a wedge fracture (54-10A).

Suspect a spine injury if there is a calcaneal body fracture (72.6), and a history of fall from a height.

If there is a fracture, especially an anterior wedge fracture, after only a minor injury, suspect that it may be pathological: the result of TB, secondary tumour or osteoporosis.

If all you can see is a widened disc space, count the spinous processes, and see if they match the vertebral bodies. *The widened disc space may be all that remains of a vertebral body!*

If the fracture is stable (54.4), an active regime of movement will give better results than a plaster cast and be cheaper.

If the fracture is unstable (54.4), *the accompanying paraplegia must dominate the management.* Conservative management almost always leads to stable union in 6-10wks. The position in which the fracture unites is unimportant.

MANAGEMENT

STABLE FRACTURE

Treat the patient in bed with fracture boards under a rubber mattress ≤10cm wide. Put a pillow between the legs and a pillow under the back when lying on the side. Retain bedrest until arching the back is sufficient for you to be able to put your hand underneath it, and until sufficiently pain-free to walk, if necessary, with crutches. Allow getting up when pain allows, usually in c.3wks.

UNSTABLE FRACTURE

If the patient is not paraplegic, maintain bedrest. Turning 2hrly in one piece, using at least 3 people, is essential. Use the right and left sides, the supine, the lateral, and the prone positions. At c.3wks, turning alone using an overhead beam attached over the bed & a handle should become possible.

When pain at rest has gone and light percussion with a clenched fist causes little pain, usually by 6-10wks, start mobilization, at first with someone either side, and then using crutches.

If the patient is paraplegic, concentrate on morale, the skin, the bladder, and the bowels, rather than on the fracture. Turning 2hrly and care for the skin (54.12) are as essential as before.

Put blocks of foam rubber underneath the patient, to minimize displacement of the spine. For example, put a block under the fracture when supine. This will encourage moderate extension and reduce the tendency of the spine to collapse. Change and adjust these blocks at each turning.

If you cannot get foam rubber blocks, or if adjusting them at each turning takes too long, continue nursing on a thick rubber mattress.

After 6-8wks in bed, when the spine is no longer painful or tender, start mobilizing as effectively as the paraplegia will permit.

CAUTION! Never apply a cast in a paraplegic. It will rapidly cause ulcers in the anaesthetic skin.

54.11 Paraplegia

The arrival of a paraplegic patient is bad news in a district hospital because it means that a bed will be occupied for a very long time. But you can work to prevent bedsores, contractures, a small contracted bladder, and all the other miseries that are only too common!

There are some very simply equipped hospitals, with very dedicated workers, who turn their patients every 2h, and *they don't get bedsores!*

It is demanding, no doubt. The care of the paraplegic is perhaps the ultimate test of the real nursing quality of your hospital, and of the morale and dedication of everyone in it.

Your aim must be for your patient:

- (1) no bedsores,
- (2) no contractures,
- (3) an uninfected bladder, with the early onset of reflex micturition in upper motor neuron lesions,
- (4) self-motivation,
- (5) mobilization,
- (6) gainful employment.

Death in paraplegics is usually from renal failure that follows chronic urinary infection; but they may live many years.

MANAGEMENT

Make your first paraplegic patient your top priority.

JABULANI (34 yrs)

Admitted with quadriparesis (not quadriplegia) one year earlier in fairly good shape, he developed pressure sores over the sacrum, both hips, both knees, and both ankles. The joints under all these lesions were open and suppurating. He developed more sores on the back and forearms, and then flexion contractures of both hips and knees. He had a chronically infected, small contracted bladder, an indwelling catheter, chronic urethritis, and suppurating paraproctitis. He soon died.

Although quadriplegics should never reach an abject state of neglect, their outlook is much worse than for paraplegics, and without sophisticated technical support, always leads to an early demise.

If not because of the complications mentioned, without intensive physiotherapy, they develop hypostatic pneumonia, and die.

Don't try to set yourself impossible targets. Paraplegics, on the other hand, are very well worth fighting for. The key to success is to prepare your staff and the patient psychologically.

DISASTER FOR A PARAPLEGIC

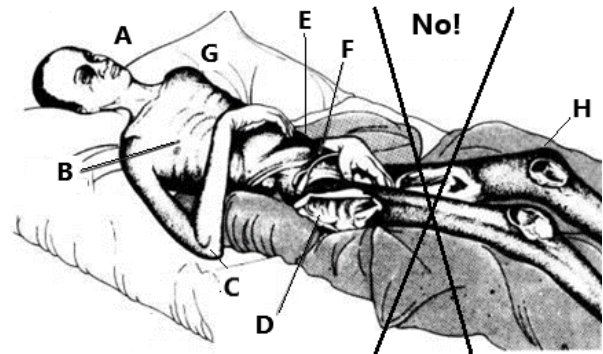


Fig. 54-18 HOW PARAPLEGICS SHOULD NOT BE TREATED. They can be saved from A, despair, B, chest infection, C, contractures, D, a dislocated hip, E bedsores, F, urethritis & a small contracted bladder, G, generalized wasting, & H, exposed joints. All it needs is turning the patient every 2h, & providing physiotherapy with a good diet. Kindly contributed by Peter Bewes

MORALE

The most critical days are the 1st few days, especially the first 2wks of admission. The whole battle may be lost by careless treatment then. Leaving a patient unturned for only 4h can start complications that need a series of surgical operations lasting many years. Moreover, if a patient develops a bed sore, you will be deemed responsible, and no other hospital will want to accept him.

A severe spinal injury is so disastrous that doctors and nurses are often too embarrassed to discuss it with the patient. Nevertheless, as such a patient is usually completely conscious and aware, you need to treat him or her with more than usual kindness!

Reassurance that you have properly diagnosed the condition, and you have urgently and carefully initiated treatment is important. *Don't try to belittle the problems;* you must explain there is a serious injury, and that the carers around understand the demands of someone paralysed. When asked whether the injury is going to be permanent, *don't be too pessimistic too early, and don't be too optimistic either!*

If, especially in spinal injuries above T6, the autonomic reflexes produce a hyperreaction to stimuli (such as a blocked catheter), causing a sudden rise >20mmHg in systolic BP, with bradycardia. If this persists, use nifedipine to lower the BP.

During the entire course of treatment, keep morale uppermost in your mind. *Don't just pass by the foot of the bed & say: "Ah, yes, the paraplegic. . .", and then pass on!*

MAKE A PARAPLEGIC'S LIFE COMFORTABLE

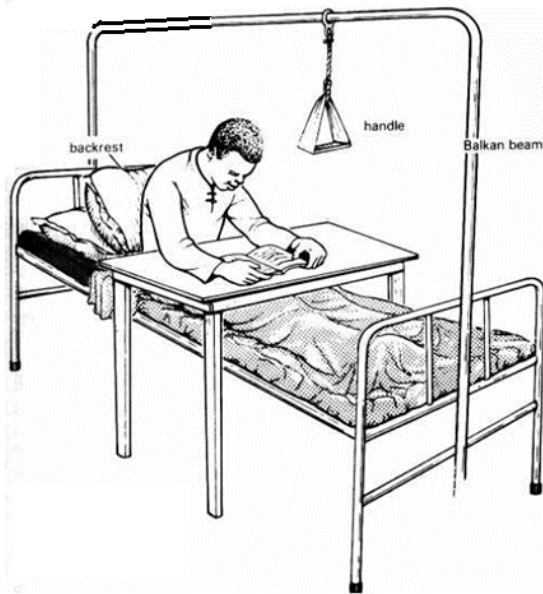


Fig. 54-19 STIMULATION FOR A PARAPLEGIC. Make sure he is always stimulated. Here he can move himself with the beam & handle. Kindly contributed by Peter Bewes.

Talk to such patients often, if not about their condition, then about their family.

Always bring encouragement and hope, not necessarily that the legs will eventually recover, but plans one day to rejoin society, and find there a place anew.

The relatives need encouragement too. It is tragic when they stop coming to visit, so make sure that someone explains your plans to them, and how long it might take.

Meanwhile, make the life as comfortable & stimulating as possible. Get in a teacher, so that the victim may learn something new (whatever level). *Don't let a patient ever get so depressed, that he or she stops eating!* Then death will be near. Make sure feeding is adequate, and watch for anaemia.

Comparing notes with other patients is very helpful. Try to organize a rota of visitors, and help in terms of entertainment. Much is made easier through mobile phones & internet!

NEVER PASS BY WITHOUT SAYING HELLO TO A PARAPLEGIC

THE SKIN

Bedsore occur in paraplegics whose skin sensation is diminished or absent, as well as any very sick or very old patient who is left in the same position too long without being turned (34.16). You can prevent them completely, even in complete paraplegia and quadriplegia, but, only provided you turn a patient every 2h *day and night*.

Get an alarm clock to alert the times for turns!

The cause of bedsore is clear. The pressure of the body on any part of the skin and subcutaneous tissue causes temporary ischaemia. In a normal person this causes mild discomfort, so that people shift about every 15mins to let another part of the body bear the weight. Because a paraplegic patient cannot feel discomfort from denervated skin, & cannot move, the skin surface subjected to pressure remains ischaemic for hrs at a time, and so becomes necrotic, breaks down, and causes a pressure sore.

If you interrupt this period of ischaemia, you can prevent a sore forming. Explain the pathology of pressure sores carefully to all your nurses and aides. Later, explain it to the patient too, so that prevention becomes part of the recovery routine. Otherwise, pressure sores become infected, and can easily reach bone or joint cavities.

TURN A PARAPLEGIC EVERY 2H & CHART THAT YOU HAVE DONE SO

Prevention must be a high priority! Put a chart at the foot of the bed, with intervals of 2h marked on it. Get nurses & aides to sign this chart each time they do the turning, and to record the side onto which they have turned the patient: left side, back, front, etc. At least 2 people are needed, and 3 are better. During the night the nurse on duty will need help, any help, even that of a relative, a watchman, a porter, or another patient. Show them how to turn gently, so that they *don't twist an unstable spinal fracture and injure it further*. In this case be sure everyone knows how to 'move someone like a log' (54-4).

ENORMOUS PRESSURE SORES CAN DEVELOP IN A VERY SHORT TIME

The discipline of absolutely invariable 2hrly turning is difficult to introduce because many nurses have seen paraplegics develop pressure sores, and think it inevitable.

Gloom and hopelessness often pervades the experience of nursing personnel. So take the initiative yourself: *lead by example!* Turn a patient yourself the first time, and next time, and perhaps the time after that.

Ask a nurse to help you. If you show yourself prepared to get up a few times at 4am and help (as some doctors have done), your nurses will play their part. Come early into the ward the next morning and inspect the pressure areas. If you find no inflammation or blistering, congratulate the nurses, and help them with their plans for turning during the rest of that day.

Offer to help turn the patient at night, if staff are short. This will prove a huge investment later! If you are called, appear delighted, and conceal your distress! Inspect the pressure areas on every ward round, and if they are healthy, congratulate the staff. At the slightest sign of inflammation, help to prepare an alternative routine of turning that will spare that part of the body from pressure for a few days.

If any important persons visit the hospital, make sure to show them the paraplegics. Involve the nurses in explaining how they turn the patient every 2h. They must follow a routine: 'left-supine-right-supine-left' for the cervical spine & 'left-supine-right-prone-left' for the lumbar spine. They will soon realize that they are becoming experts in this exacting field. Such co-operation will speak volumes to the visitors!

After a month or two, the patient, and the relatives will work out their own routine for turns, and plan how to manage at home.

After a few months it will become almost a reflex for turning to be carried out in bed at home.

Try to get your patient into a wheel chair or calipers quickly. Then teach how to avoid getting further pressure sores.

If there is only paraparesis and calipers are worn, inspect where they press on the skin, to avoid pressure sores at that site.

Each time you turn a paraplegic, put all immobile joints through a full range of passive movement, concentrating on hip and knee extension and dorsiflexion of the ankles.

Make sure the bed support is firm but soft. A covered mattress with 20cm foam interior is ideal. Put soft pillows or foam rubber cushions between the legs and under the back.

Try to keep the patient's bottom sheet tight, dry, and free from creases, crumbs, and bits of food. *Avoid plastic draw sheets, incontinence pads, & starched sheets.* Use real sheepskin if possible; medically treated, and washable, the woolen fibres help to distribute pressure, absorb moisture and promote air circulation, improving comfort overall.

Pad the pressure points with cotton wool, gauze, or pieces of fleece, but watch these pads carefully. *Don't allow them to become creased.* Remove them at least once a day and check the skin under them.

If the heels show any sign of pressure sores, put a pad under the ankles, or a ring pad around the heels. *Don't pad pressure points:* pad around them.

Watch the skin over the sacrum, iliac crests, hips, sides of the knees, malleoli, and the penis if there is a condom catheter in place.

The first sign of a sore is skin inflammation; this might be difficult to spot on dark skin; it is characterized by a loss of natural shininess. Treat any such areas by careful massage and then apply soap and water followed by careful drying and powder.

For an established sore, keep pressure off it until it has healed. Keep it clean. Use paraffin gauze dressings. Honey and the fruit of the papaya (paw-paw), which contains the enzyme papain, are also useful.

Small sores may heal slowly, if you keep them clean and protected.

If a sore is necrotic, remove all the dead tissue. You may well find a much larger area of necrosis or sepsis underneath. Such large sores need debridement in theatre, and later closure by flaps (34-19 to 25).

TURNING A PARAPLEGIC NEEDS AT LEAST 3 PEOPLE

THE BLADDER

With any significant degree of paraplegia, a patient will be unable to urinate voluntarily from the moment of the injury. The bladder will fill up slowly and will be full by about midnight on the day of admission. If you leave it, it will overflow, so anticipate this and prevent it.

The best way of emptying the bladder to minimize introducing infection is to use regular intermittent *sterile* catheterization. Infection is rare with this method. It imitates the natural cycle in which the bladder fills and empties. By leaving it almost empty for a significant period, this method relieves the pressure on its walls, both that of urine filling the bladder and pressure from the the balloon of a Foley catheter on the urethra.

Use a Ch14 soft rubber Jacques catheter. Boil it and use gloved hands or sterile forceps. Pass it every 4-6h from the moment of the patient's injury. Later it can be every 6-8h. Empty the bladder completely by suprapubic pressure and then remove the catheter. Repeat the process 6h later, and again and again, x4/day. Record that catheterisation has been done on the chart which is used to record when you do the turning.

The disadvantage of this method is that it requires more nursing care, and if the patient is to do it himself, he must be cooperative.

Some smaller hospitals have managed this excellently.

CAUTION! When you make rounds, check the bladder from time to time to make sure that it really is being emptied. Continue, either until the spinal cord recovers, or until an automatic bladder develops, usually in 2-3 months.

Don't use either an indwelling catheter or continuous suprapubic drainage, because their inevitable result is chronic or recurrent ascending infection & a small contracted bladder.

CATHETERIZE THE PARAPLEGIC WITH FULL STERILE PRECAUTIONS

RESULTS OF 2 REGIMES FOR A PARAPLEGIC BLADDER

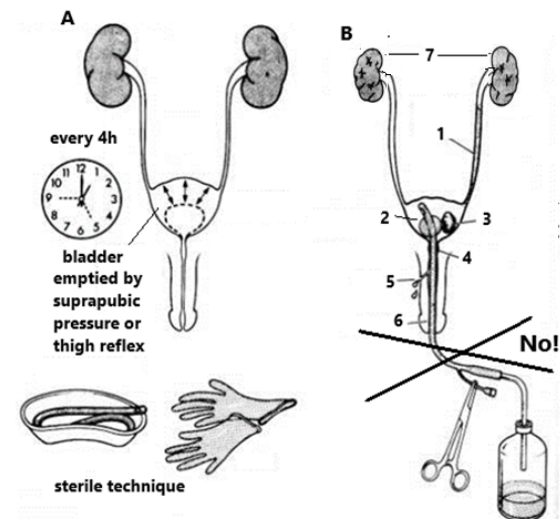


Fig. 54-20 RESULTS OF 2 REGIMES FOR A PARAPLEGIC BLADDER. A, Bladder emptied by suprapubic pressure or thigh reflex, or intermittent catheterization. Early on, get the ward staff to do this in a sterile manner. Later, get the patient to do it himself in a clean manner. B, an indwelling catheter can produce complications such as: (1) ascending urinary infection, (2) small contracted bladder, (3) bladder stone, (4) urethral stricture, (5) urethral fistula, (6) urethritis. (7) small contracted kidneys. Kindly contributed by Peter Bewes.

TYPES OF NEUROGENIC BLADDER

(a) Spastic bladder

If the spinal injury is above T10, the *detrusor* muscle does not work in harmony with the sphincter and produces a hyper-reflexive 'upper motoneuron' bladder. This will usually eventually develop its own micturition reflex.

After 2-8wks' intermittent catheterization a method of initiating micturition may be possible by the patient. Fit a condom catheter or a Paul's tube and encourage trying, e.g. by stroking the side of the thigh, or the penis, or by pressing suprapubically.

Such training may take a long time; it is not easy, and may require considerable persistence and patience.

Although training may be difficult, it will save time in the end. After finding a method which works, encourage its use more and more. *Allow this without a catheter in situ.* Don't stop using intermittent catheterisation until the residual urine after micturition has fallen to ≤ 75 ml. Even when it has fallen to this volume, catheterize once a week to make sure that there is no urinary retention.

If you find that the residual urine is >75 ml, consider a bladder neck incision (27.21).

(b) Flaccid bladder

If the bladder is disconnected from its peripheral nerve supply, the bladder distends and the patient becomes incontinent because of overflow. The bladder needs catheterization.

A patient can do this either by sterilizing a catheter in boiling water each time and passing it in a sterile manner, or by a clean no-touch technique.

Surprisingly perhaps, because a patient does not need to sterilize the catheter each time, he can catheterize himself more often, whenever he needs to, and so does not allow the bladder to fill up. In practice, he becomes infected less often than if he waits and tries to sterilize a catheter.

For this method to succeed, *he must empty the bladder as completely as possible with the help of suprapubic pressure continued until the moment that he pulls the catheter out.*

An incompletely emptied bladder will retain some organisms, but a bladder that is completely emptied will contain very few.

JOHN (45 yrs)

As a former league football player before the accident which left him paralyzed, John just had to go to the semi-final match. Here he could cheer wildly with his mates, and in the interval go to the toilet, catheterize himself, and then return to the match! If he'd have had to sterilize the catheter, he just would not have been able to go to any such matches ever, or go and allow the bladder to fill up, cause reflux & infection, and run the risk of embarrassing overflow incontinence. Alternatively, he would have had to carry the catheter with a bag, and empty it at half time, running all the risks of longer-term catheterization.

Many patients easily learn this method which has the principal advantages of allowing them freedom & independence.

INTERMITTENT SELF-CATHETERIZATION

Provide a man a Jacques rubber catheter, or if there is difficulty, use one with a small beak, such as an olivary tipped Tiemann, or a coudé catheter. Teach him which way to point the beak.

A woman may use a small handbag mirror to help her locate the urethral meatus.

Encourage the patient to keep the catheter clean, wash the hands and the urethral orifice.

If the urine becomes cloudy or smelly, encourage more frequent catheterization. (The usual reason for the infection is infrequent drainage). Use an antibiotic depending on a culture & sensitivity test.

Don't try to prevent infection by administering prophylactic antibiotics, but alkalinizing the urine may help.

If these 2 methods fail, admit for continued, intermittent, non-sterile catheterization under supervision, together with bladder wash-outs.

If this also fails after 1-2yrs, the spinal injury is below T12 & there is no bladder outlet obstruction & no incontinence, surgical augmentation of *detrusor* bladder contraction may be possible:

RECTUS ABDOMINIS DETRUSOR MYOPLASTY (GRADE 3.1)

Through a midline abdominal incision, open the rectus sheath and expose the left *rectus abdominis* muscle. Free it from surrounding structures, but *not from the posterior rectus sheath*. Mark the resting length of the muscle with stay sutures. Identify, ligate & divide the superior epigastric artery. Dissect out its entire length and divide it at its superior end. Identify & carefully preserve the intercostal nerves on the surface of the *rectus abdominis* (54-21). *Don't disconnect the muscle from the symphysis pubis.*

Now mobilize the bladder & fill it with 100mL of saline. Noting its resting length, use the *rectus* muscle flap to wrap around the upper $\frac{2}{3}$ (the dome and lateral walls) of the bladder. As you fix the flap, if you can, anastomose 2 intercostal nerves of the upper part to 2 intercostal nerves of the lower part with 8/0 nylon. You can check muscle contractility by stimulating the muscle or nerve.

Finally close the abdominal wall. Keep an indwelling catheter in place for 3wks.

Then teach the patient to empty the bladder as completely as he can by squeezing the *rectus* muscle.

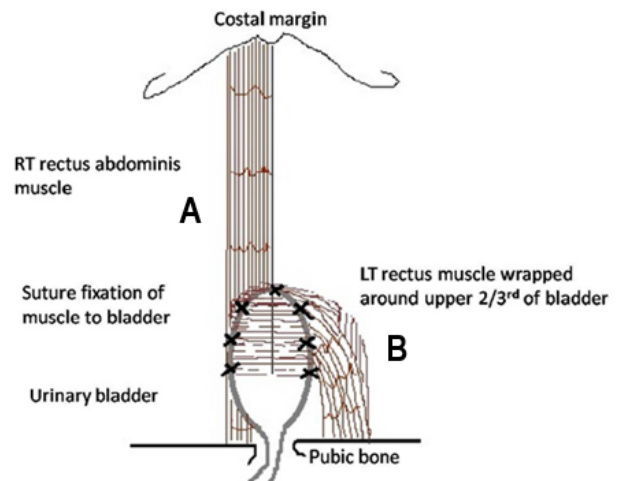
RECTUS ABDOMINIS DETRUSOR MYOPLASTY

Fig. 54-21 RECTUS ABDOMINIS DETRUSOR WRAP. A, the right *rectus abdominis* muscle undisturbed. B, the left *rectus abdominis* muscle, after being divided at its upper end, wrapped & fixed around the upper $\frac{2}{3}$ of the mobilized bladder. After Agarwal P, Husain S, Wankhede S, Sharma D. *Rectus abdominis detrusor myoplasty for acontractile or hypocontractile bladder in spinal cord injury patients.* J Plas, Reconst Aesth Surg 2018; 71: 736-742.

BOWELS & NUTRITION

After a spinal injury, the bowel quickly becomes loaded with brick-like faeces. Distension may become so severe that the sigmoid colon presses on the left iliac vein and may cause a thrombosis in it.

Administer an enema x3/wk until bowel function has returned, usually in 3-6wks.

Glycerine suppositories later on may help develop a defecation reflex. It may be possible for the patient to start this reflex by inserting a suppository and sitting on the lavatory 15mins later.

Even so, faecal impaction is always a danger, and you should teach the patient or the relatives the unpleasant task of how to remove faeces manually. *This is so important that it should be part of the routine teaching of everyone who cares for paraplegics.*

You can do much by, occasionally, manually removing faeces yourself (without demonstrating your disgust at doing this) and so encourage the nurses to follow your example. Make sure that the patient has a high residue diet and uses non-irritant laxatives if necessary.

Also make sure the patient has a high protein, high calorie diet in the first 3 months of the injury. You may need iron supplements to keep the Hb level >120g/L.

MUSCLES AND JOINT PHYSIOTHERAPY

From the very start, get a concerned person (or team of people) to move all the paralysed joints passively through a full range of movements several times a day. This will become more difficult as the patient becomes more spastic. *If this is neglected, the hips, knees, and ankles will roll up like a hibernating hedgehog.*

Established contractures are readily preventable, and therefore are a sign of neglect. Where possible, sit a patient up out of bed. Although physiotherapists are useful, you can trach any doctor, nurse, or relative how to put the joints through a full range of movements every day, and so prevent contractures. *Avoid force*, because this may damage a joint. Encourage movement of the non-paralysed joints as much as possible. The hips of a paraplegic tend to flex; *so, don't provide a pillow under the hip when the patient is lying prone!*

MOBILIZATION & REHABILITATION

If you don't interest yourself in what happens to a paraplegic after discharge, there is a very great chance that all the care and attention received while in hospital may be wasted. This is especially likely to happen in rural areas. So arrange a visit the patient's home, and try to make sure that he has a suitable bed and toilet, and can get involved in daily household duties.

REHABILITATING A PARAPLEGIC



Fig. 54-22 REHABILITATING A PARAPLEGIC is critically important. All wheelchair users need a cushion (preferably with gel-foam) to sit on. Failure to do so after discharge will be fatal, owing to sure development of pressure sores. *Kindly contributed by Peter Bewes.*

The process of rehabilitation requires solutions to various issues. Can a wheelchair come into the front door? Are there steps? Can you fit parallel bars? Can you adapt things for a lower (chair) level, such as mirrors, handles etc.? Can you fit hoists & monkey poles for the patient to transfer himself?

Often, money will be the major factor. If a patient was injured at work, a workmen's compensation fund may be able to support him.

Start to mobilize a patient when the fracture is reasonably stable and it is clear that the paralysis will be permanent.

Stand a paraplegic up regularly when the arms are strong enough to hold crutches. Use gutter plaster splints or walking calipers to support the knees and ankles.

Involve the whole family in rehabilitation. There will be need of a wheel chair, and perhaps calipers and crutches to take home. Start thinking early about how to finance these. The 1st week of the illness is not too early for this, and often the best time when people's emotions are raw.

Early on during the stay in hospital, encourage developing extraordinary strength in the unparalysed parts of the body.

Encourage pulling up using an overhead beam, or lifting weights with the arms, so that they are strong enough to support the body when using crutches or a wheelchair. Calipers may help to keep the knees straight and the feet in neutral positions. Teach some skills with the hands, such as making articles for sale, basket making, weaving, or leather work. Encourage finding markets for the things produced, so that later on this means earning a living.

Aim for a date of discharge 4-5 months after admission. Try to get the community involved in re-integrating the patient with suitable employment.

Success in rehabilitating paraplegia is one of the best indicators of high quality care. Where it fails, a district hospital accumulates 3-4 paraplegics, and a provincial one perhaps 12, each with an average total stay of perhaps 10 years, with all that this means for expense, and for the other patients who have to be denied treatment.

WHEELCHAIR USE

Start a patient in a wheel chair slowly, 2h od to begin with, then 2h bd. It is important to lift up the buttocks a few times every 15mins.

Sitting needs to be on 2 foam rubber cushions, or on an inflated inner tube of a motor cycle that has small wheels and wide tyres.

Cover this with a foam pad. Provide a washable rubber bag for those times the bladder works unexpectedly.

If skin sores or a urinary infection develop, a rapid return to hospital is mandatory.

If a leg becomes hopelessly infected, and a liability, this is an indication for a through-knee or above-knee amputation (35.6). It may not only remove a life-threatening source of sepsis, but allow better and easier mobilization. Sitting may still be difficult.

N.B. Don't remove both legs on the same occasion.

**PARAPLEGIA CAN BE TREATED
PROPERLY IN A DISTRICT HOSPITAL**