Injuries to the lumbar spine: identification and management

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Fifteen percent of spinal injuries occur in the lumbosacral region. Damage to the spinal cord or cauda equina is a possible complication. Thorough assessment of all trauma patients for such injuries will result in early diagnosis and optimal outcome can be achieved. This article looks at the identification and management of injuries to the lumbar spine.

Injury to the spine must always be actively sought and excluded in any trauma scenario. Approximately 5% of patients with a head injury will have an associated spinal injury and 15% of all spinal injuries occur in the lumbosacral region (Ali et al, 1997). A sound understanding of these injuries and their treatments is vital in optimizing outcome.

ANATOMY

The lumbar spine consists of the five lumbar vertebrae with attached muscles and ligaments, and the spinal cord and cauda equina within a dural sac.

The spinal cord terminates at the inferior border of the L1 vertebral body becoming the cauda equina, which is comprised of sensory and motor nerve roots. These nerve roots have proportionally more room within the bony confines of the spinal canal than the spinal cord in the cervical and thoracic spine, meaning that neurological injury is less likely with lumbar fractures than with injuries at other levels.

It is useful to consider the spine as three columns as described by Denis et al (1983) (*Figure 1*). The three columns are:

- Anterior column – consists of the anterior longitudinal ligament, the anterior half of the vertebral body and annulus.
- Middle column – consists of the posterior longitudinal ligament and the posterior half of the vertebral body and annulus.
- Posterior column – consists of the pedicles, facets, laminae and posterior ligamentous complex (supraspinous, infraspinous, ligamentum flavum and facet joint capsules).

An injury is deemed unstable if any two of the three columns are involved. However, thoracolumbar injury stability usually follows

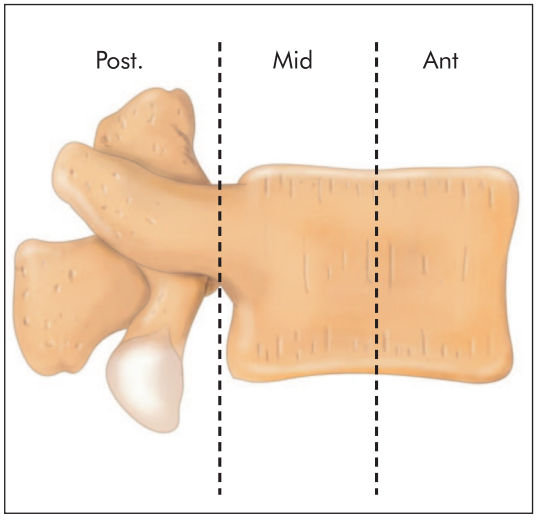

Figure 1. The spine as three columns (anterior, middle and posterior) as described by Denis et al (1983).

Figure 2. To immobilize the cervical spine the head must be supported between the arms and fixed in relation to the neck and shoulders.

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Figure 3a. Triple immobilzation using collar, blocks and tape.

Figure 3b. Triple immobilzation using collar, blocks and tape.

middle column integrity; if this is intact then the injury is usually stable.

INITIAL MANAGEMENT OF TRAUMA

The principles of spinal trauma management are as per advanced trauma life support (ATLS) protocol. With any suspicion of spinal injury patients should be triple immobilized and strapped to a long spinal board. Any transfers should be conducted by formal log roll until the spine has been cleared by examination and/or xrays. Standard observations need to be monitored for any sign of neurogenic shock (hypotension without tachycardia or peripheral vasoconstriction) which indicates dysfunction of nervous tissue due to physiological causes.

Triple immobilization

The cervical spine can only be immobilized manually (*Figure 2*) by supporting the head between the arms and fixing in relation to the neck and shoulders or through triple immobilization using a correctly fitting collar, blocks and tape (*Figure 3*). When fixing a patient to a long spinal board or trolley the c-spine should always be controlled manually until the rest of the body has been secured.

Log roll

The log roll is a method for moving and examining a patient while excluding movement of the spine. It requires a minimum of five people, four to move the patient and one to examine the spine. All directions come from the 'leader' who is responsible for manual control of the c-spine (*Figure 2*). Three people now position themselves along one side of the patient, one responsible for the chest and upper limbs (*Figure 4*), one for the pelvis (*Figure 5*) and one for the lower limbs (*Figure 6*). If there is any suggestion of trauma to one particular side it is sensible to roll onto the unaffected side.

Figure 4. Positioning for support of chest and upper limbs.

The examiner takes up position on the other side of the patient and, provided they are conscious, explains the procedure of the examination with particular emphasis on the necessity to answer 'yes' or 'no' as the spine is palpated for bony pain as opposed to nodding agreement.

The leader then announces 'ready, brace, roll' at which point the patient is rolled to 90º towards the team (*Figure 7*). The examiner now inspects the spine looking for areas of obvious

TABLE 1.
Classification of lumbar fractures

	Column		
Fracture	**Anterior**	**Middle**	**Posterior**
Compression	Compression	None	None/Distraction
Burst	Compression	Compression	None/Distraction
Flexion/Distraction	None/Comp.	Distraction	Distraction
Fracture/Dislocation	Comp. +/- Rotation/Shear	Distraction +/- Rotation/Shear	Distraction +/- Rotation/Shear

Figure 5. Positioning for support of the pelvis.

Figure 6. Positioning for support of lower limbs.

Figure 7a. 'Ready, brace, roll' position.

Figure 7b. Patient is rolled 90° towards the team.

trauma (e.g. contusion, bleeding, laceration) and palpates for any obvious steps or tenderness along every spinous process. The examination is not complete until sacral nerve roots have been assessed by rectal examination for perianal sensation and anal tone.

MECHANISMS OF INJURY

Most trauma to the lumbar spine occurs in the context of road traffic accidents and falls from a height. The remainder result from sporting activity or acts of violence.

CLASSIFICATION OF INJURIES

The bony architecture of the lumbar spine is normally disrupted in one of four patterns as a result of trauma. These can be summarized according to their effects on the three anatomical columns as described by Denis et al (1983) (*Table 1*).

Compression

This arises as a result of lateral or anterior flexion that produces failure of the anterior column. These injuries are usually stable and rarely cause neurological impairment.

Burst

A burst fracture is commonly associated with a fall from a height and is a result of axial load causing a failure of the vertebral body and disruption of the anterior and middle columns. Burst fractures can be further subdivided into five characteristic patterns (*Figure 8*). The five patterns are:

- Superior and inferior vertebral body end plates
- Superior vertebral body end plate
- Inferior vertebral body end plate
- Rotational
- Lateral wedging of vertebral body.

Flexion/distraction

Classically associated with deceleration forces while restrained by a lap seat belt fracture/distraction injuries arise from a distracting force across the three columns with the anterior column acting as the centre of rotation. If this only involves osseous structures it is known as a Chance fracture (Chance, 1948), but it may disrupt any of the ligamentous structures (*Figure 9*). Neurological deficit is only likely to arise if there is a significant degree of

translation between affected segments. If this is the case it is more likely to be a fracture/dislocation injury.

Fracture/dislocation
These injuries show disruption of the bony and ligamentous structures of all three columns through a combination of compression, rotation, tension and shear forces. The fracture line can run across the vertebral body or the disc space. The displacement can occur in posterior-anterior (PA) direction, where the superior segment slides forwards (as in a heavy load on the back), or an anterior-posterior (AP) direction. In a PA direction the facets prohibit the anterior displacement of the posterior arch of the vertebra which subsequently often fractures in multiple locations and detaches from the lamina. For this reason dural tears, and neurological injury, are far more common with this injury than with AP displacement (Bolesta et al, 1996).

NEUROLOGICAL INJURY

Neurological damage from the above can be classified according to the nature of the insult to the axonal structures.

Contusion
This is responsible for the majority of injuries and constitutes a sudden, but brief increase of pressure on the cord/nerve roots. This is usually irreversible and associated with vascular injury and intra-medullary haemorrhage.

Compression
Compression reduces the size of the spinal canal and is normally associated with a translation or angulation deformity (e.g. burst injuries and disc herniation). It interferes with both axonal flow and spinal vasculature which can lead to secondary ischaemia and further insult.

Stretch
Stretching occurs with a flexion/distraction injury and leads to capillary and axonal collapse secondary to tensile distortion.

Laceration
Lacerating injuries to the spinal cord can be a result of foreign bodies or bony fragments that occur with a translational fracture through the vertebrae.

Level and extent of injury
In addition to recording the vertebral level of injury it is very important to quantify the degree of neuronal injury since this is a key prognostic

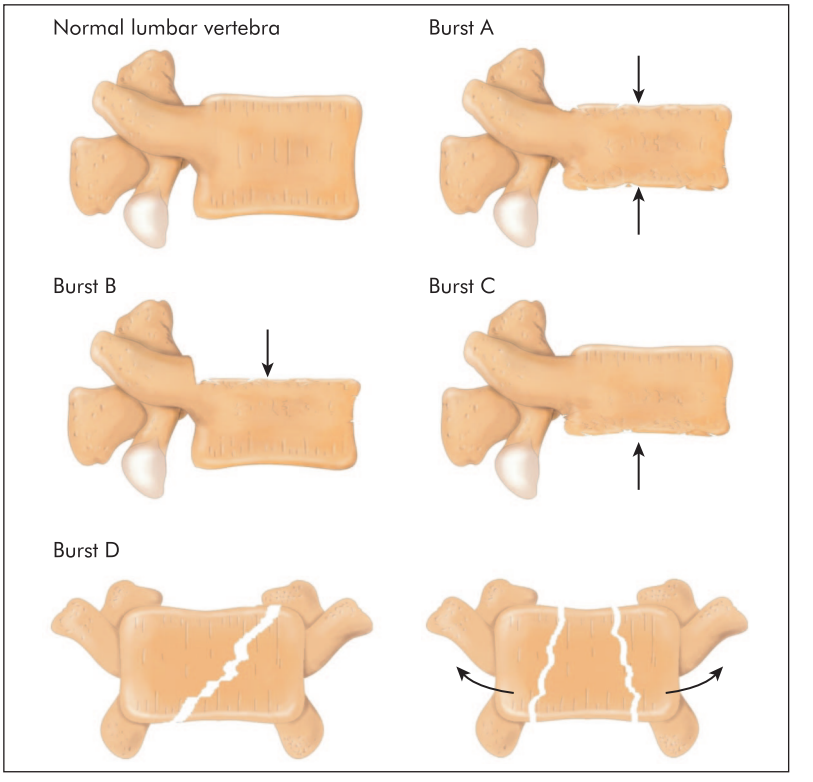

Figure 8: Five characteristic patterns of burst fractures; A: Superior and inferior vertebral body end plates, B: Superior vertebral body end plate, C: Inferior vertebral body end plate, D: Rotational and E: Lateral wedging of vertebral body.

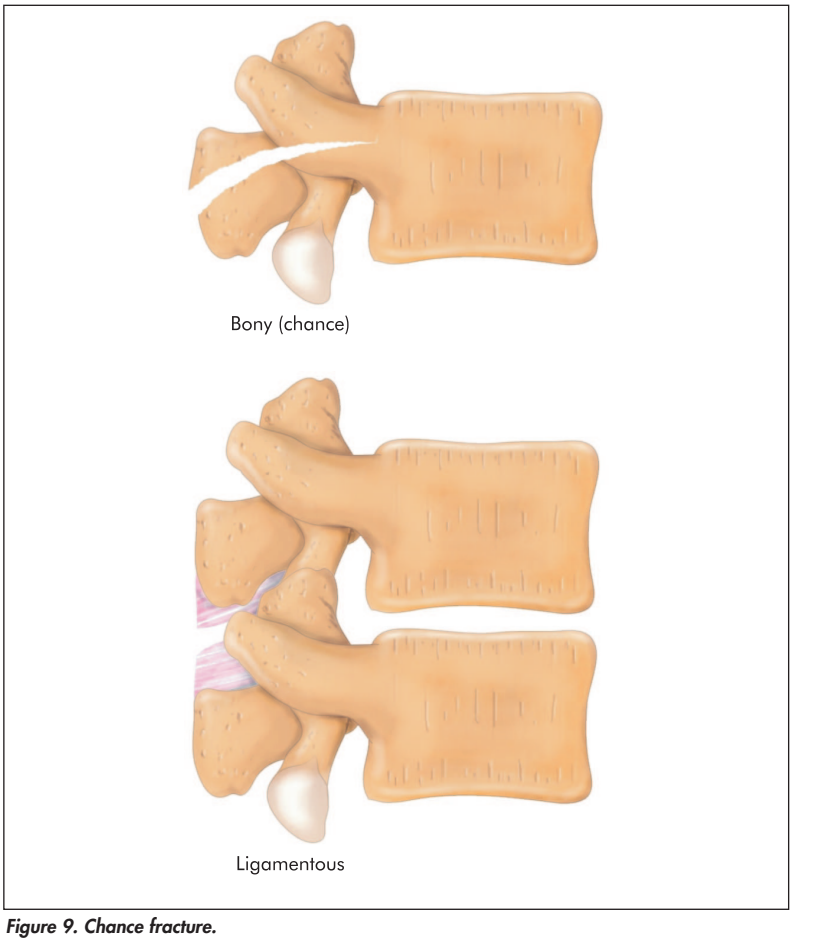

Figure 9. Chance fracture.

indicator. It is vital to ascertain and record whether the injury is complete or incomplete.

A complete injury is one where there is no motor or sensory function caudal to the injury and the bulbocavernosus reflex is intact. If this S3-4 reflex arc is functional spinal shock can be ruled out as a cause of deficit.

Injuries where there is some degree of function below the level of the injury, be it motor or sensory are classified as incomplete. The more function that remains the better the prognosis for recovery. Any sacral sparing (perianal sensation, voluntary rectal motor tone, flexion of the great toe) shows that there is at least partial continuity of the white matter long tracts and that the injury is incomplete. It is important to remember that sacral function might be the only deficit and must be both examined and documented.

It is possible to record the degree of injury according to the Frankel Classification (Frankel et al, 1969). This is as follows:

- A: Absent motor and sensory function
- B: Sensory intact, absent motor function
- C: Sensory intact, motor function 2-3/5
- D: Sensory intact, motor function 4-5/5
- E: Sensory and motor function intact

CONCLUSIONS

Injuries to the lumbar spine account for 15% of spinal injuries and may be associated with neurological disruption. It is vital to make a full, documented neurological examination of the lumbar-sacral nerve roots, including perianal sensation and anal tone in any trauma patient. Triple immobilization on a long spinal board is essential until the spine can be cleared by physical examination and xrays, particularly in the presence of any distracting injuries. HM

Conflict of interest: none

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KEY POINTS

- Fifteen percent of spinal injuries occur in the lumbosacral region.
- Triple immobilzation on a spinal board during patient transfer will help minimize further injury.
- Initial assessment of all trauma patients should include assessment of the lumbar spine during initial 'log-roll'.
- Neurological injuries caused by trauma to the spinal cord or cauda equina are possible complications.
- Early diagnosis is essential in optimizing outcome.