

Thoracolumbar Fracture

A patient guide

In brief: A thoracolumbar fracture is a break of one of the vertebrae at the junction between the chest (thoracic) and lower back (lumbar) regions of the spine, conventionally the segment running from T10 to L2. This short stretch of spine is the single commonest site of vertebral fracture, and the injuries that occur here range from mild, stable wedge compressions through to severe, unstable fracture-dislocations. This page serves as an overview that ties together the individual fracture patterns and explains why this transition zone fractures so readily, how the injuries are classified, and how they are distinguished from one another.

Why the thoracolumbar junction is the commonest fracture site

The reason the thoracolumbar junction fractures more often than any other part of the spinal column is mechanical rather than coincidental. It marks the boundary between two very different regions of the spine, each built to behave in a different way.

Above the junction sits the thoracic spine. This region is comparatively rigid and gently rounded forwards into a kyphosis. It is splinted and braced by the rib cage and the breastbone, which act together rather like a barrel that shares and distributes load. The small facet joints that link one thoracic vertebra to the next are oriented in a near-vertical, side-to-side (coronal) plane, an arrangement that favours rotation but strongly resists bending forwards and backwards. The result is a stiff, buttressed column that carries force in a stable configuration and resists deformation.

Below the junction sits the lumbar spine. This region is mobile and curved the opposite way, into a lordosis. Its facet joints are oriented in a front-to-back (sagittal) plane, which permits a great deal of flexion and extension, and there is no rib cage to share the load. The lumbar spine is therefore built to move and to absorb force through that movement.

At T10 to L2 the spine changes abruptly from stiff-and-kyphotic to mobile-and-lordotic. The facet joints reorient, the supporting rib cage falls away, and the curve reverses from kyphosis to lordosis over a very short distance. A bending or compressing force that the thoracic spine would buttress and distribute, or that the lumbar spine would absorb through motion, is instead concentrated at this narrow point of transition. The junction therefore fails before the regions on either side of it.

The numbers reflect this. The thoracolumbar junction accounts for roughly half of all vertebral fractures and for the majority of traumatic vertebral fractures. L1 is the single most frequently fractured vertebra in the entire spine, followed closely by T12. A substantial proportion of these injuries are mechanically unstable, and a minority involve injury to the nervous tissue, because the conus medullaris, the tapering lower end of the spinal cord, typically lies at about the L1 level. A fracture here can therefore affect the lower cord, the conus and the cauda equina nerve roots in combination, which is part of what makes the region clinically important.

The spectrum of injuries (compression to burst to Chance to fracture-dislocation)

Thoracolumbar fractures are best understood not as a list of unrelated injuries but as a single spectrum, running broadly in order of increasing energy and increasing instability. The classification systems described later exist precisely to place a given injury along this spectrum. Four main patterns are recognised, and each has its own detailed page.

****Compression (wedge) fracture.**** The mildest and commonest pattern. Here the front part of the vertebral body is crushed while the back wall of the body remains intact. The vertebra takes on a wedge shape, shorter at the front than the back. Because the failure is confined to the front of the bone and the structures that resist tension at the back are preserved, most of these injuries are mechanically stable.

****Burst fracture.**** A higher-energy injury in which the vertebral body fails under axial compression and the back wall of the body is involved, not just the front. Because the posterior wall is broken, fragments of bone can be pushed backwards (retropulsed) towards the spinal canal. Burst fractures occupy the middle of the spectrum and span a wide range, from stable injuries through to clearly unstable ones, depending on how much of the bone and the back-of-spine ligaments are involved and whether nerve tissue is compressed.

****Flexion-distraction (Chance) injury.**** A pattern caused by the spine being violently bent forwards over a fixed point, classically the lap-belt mechanism in a road traffic collision. The back of the spine is pulled apart under tension while the front is compressed, so the bone, the ligaments, or both can split horizontally. These injuries disrupt the tension band at the back of the spine and are generally considered unstable.

****Fracture-dislocation.**** The most severe and highest-energy pattern, in which all the supporting structures fail and one part of the spine shifts or rotates relative to the part below it (translation or rotation). This is the most unstable pattern and carries the highest risk of neurological injury.

The progression from compression to burst to Chance to fracture-dislocation is, in effect, a progression in how many of the spine's supporting structures have been disrupted, and in which direction the failure has occurred.

The three-column concept and the posterior ligamentous complex

A simple and durable way of describing how badly a thoracolumbar fracture has disrupted the spine is the column concept, first set out by Holdsworth as a two-column model and later extended by Denis into the three-column model that remains in widespread use.

In the three-column model the vertebra and its surrounding structures are divided, from front to back, into three vertical columns:

- The ****anterior column****: the front half of the vertebral body and the front part of the intervertebral disc, together with the anterior longitudinal ligament.
- The ****middle column****: the back half of the vertebral body, the back part of the disc, and the posterior longitudinal ligament. This is the key column, because the back wall of the vertebral body forms the front edge of the spinal canal.
- The ****posterior column****: the bony arch behind the canal (the pedicles, facet joints, laminae and spinous process) together with the posterior ligamentous complex.

The value of this model is that it links the pattern of failure to stability. A compression fracture disrupts the anterior column alone and is generally stable. A burst fracture, by definition, involves the middle column. When two or more columns are disrupted, the injury is generally regarded as unstable.

The ****posterior ligamentous complex****, often abbreviated to PLC, deserves particular mention because it has become central to modern decision-making. It is the group of strong ligaments at the back of the spine, including the supraspinous and interspinous ligaments, the ligamentum flavum and the facet joint capsules. Functioning together, they act as a tension band, resisting the spine bending forwards in the same way that a strap across the back of a hinge resists it opening. When this tension band is torn, the spine loses an important restraint and the injury behaves in a more unstable way. Whether the posterior ligamentous complex is intact or disrupted is one of the most important single factors distinguishing injuries that are generally managed without surgery from those that are generally managed with surgery, and it is one of the main reasons magnetic resonance imaging is used in

this region.

The classification systems (Denis, AO Spine, TLICS, Load-Sharing)

Several classification systems are used to describe thoracolumbar fractures. They are best thought of not as competitors but as an evolving conversation, each adding something the previous one lacked. All of them try to answer the same three questions: what broke, is it stable, and is an operation generally considered.

****Denis (three-column).*** Building on Holdsworth's earlier two-column idea, the Denis system, introduced in 1983, defines instability anatomically by how many of the three columns are disrupted. Disruption of two or more columns is generally taken to indicate instability. It remains a clear and widely taught conceptual framework.

****AO Spine thoracolumbar classification (A/B/C).*** This system, descended from the comprehensive Magerl/AO classification of 1994 and brought to its current form in 2013, groups injuries by their mechanism and morphology into three main types. Type A injuries are compression injuries of the vertebral body, ranging from minor wedges to full burst fractures. Type B injuries are tension-band (distraction) failures, in which the front or back restraints are pulled apart, as in a Chance injury. Type C injuries are translation injuries, in which one part of the spine has displaced relative to another, as in a fracture-dislocation. The letters therefore run in order of increasing severity. The system also records the patient's neurological status and certain modifiers, and an associated severity score can be used to guide treatment. Its reliability has been tested and confirmed by independent international groups.

****TLICS (Thoracolumbar Injury Classification and Severity Score).*** Introduced in 2005, TLICS takes a scoring approach rather than a purely descriptive one. It awards points for three things: the morphology of the fracture (compression, burst, translation/rotation, distraction), the integrity of the posterior ligamentous complex (intact, suspected, or disrupted), and the patient's neurological status (intact, nerve root, complete or incomplete cord, or cauda equina). The points are summed; in general terms a low total points towards non-operative management and a high total towards operative management, with an intermediate score regarded as a grey zone. By building the posterior ligamentous complex and neurology directly into the score, TLICS makes explicit the factors that most influence stability.

****McCormack Load-Sharing classification.*** This is an adjunct rather than a stand-alone description of the injury. It scores the degree of comminution (how broken into fragments the vertebral body is), the spread of the fragments, and the amount of correction needed. It does not decide whether to operate, but where surgery is undertaken it helps inform the choice of surgical approach and construct, for example whether reconstruction of the front of the vertebra is likely to be needed in addition to fixation from behind.

Taken together, these systems allow a given fracture to be described consistently, sorted along the spectrum from stable to unstable, and discussed in a common language between clinicians.

How it tends to present (incl. conus-level neurology)

Thoracolumbar fractures most often follow a clearly identifiable event: a fall from height, a road traffic collision, a sporting impact or, in older people or those with weakened bone, a comparatively minor fall or even a vigorous everyday movement. The usual presenting feature is pain across the back at the level of the junction, which is often worse on movement and on weight-bearing. There may be localised tenderness and bruising over the spine, and in flexion-distraction injuries a tell-tale band of bruising across the abdomen from a lap belt is sometimes seen.

Because the conus medullaris, the tapering end of the spinal cord, commonly lies at around the L1 level, injuries here can affect the nervous tissue in a way that fractures lower in the lumbar spine usually do not. Neurological involvement at this level may show itself as weakness or altered sensation in the legs, and because the conus and

the cauda equina nerve roots govern the bladder, the bowel and sexual function, disturbance of these functions can also occur. The mixture of cord, conus and nerve-root tissue packed into this short segment means the pattern of any neurological injury can be complex, which is why a careful neurological assessment forms part of the evaluation of any significant fracture in this region. Where high-energy mechanisms are involved, injuries to the chest, abdomen and other parts of the skeleton frequently accompany the spinal fracture.

How it is assessed (CT, MRI)

Imaging is central to characterising a thoracolumbar fracture, and the different modalities provide complementary information.

Plain radiographs (X-rays) may be the first images obtained and can show the overall alignment of the spine, loss of vertebral body height and an increase in the local kyphosis. They give a useful overview but cannot show the bone or the soft tissues in fine detail.

Computed tomography (CT) is the principal modality for the bone. It demonstrates the fracture lines in detail, shows whether the posterior wall of the vertebral body is involved (the feature that distinguishes a burst fracture from a simple compression), and reveals any fragments of bone that have been pushed back towards the spinal canal. CT also allows measurement of how much the canal is narrowed and of the degree of comminution, information that feeds into the load-sharing assessment. In the setting of significant trauma, CT is generally regarded as the primary imaging investigation.

Magnetic resonance imaging (MRI) shows what CT cannot: the soft tissues. It is the modality of choice for assessing the posterior ligamentous complex, where it can reveal a tear that is invisible on CT, and for this reason MRI findings have been shown to change both the classification and the planned management of these injuries in a meaningful proportion of cases. MRI also shows the intervertebral discs, any bruising within the bone, and, crucially, the spinal cord, conus and nerve roots themselves, so it is particularly valuable where there is neurological involvement or where the integrity of the tension band is in doubt.

How stability is judged

Stability is the central concept that runs through every classification system and largely determines how a thoracolumbar fracture is generally approached. In broad terms, a stable injury is one in which the spine can be expected to bear normal loads and maintain its alignment without progressive deformity or risk to the nervous tissue, whereas an unstable injury is one in which the supporting structures have been disrupted to the point that the spine can no longer reliably do this.

Several features are weighed together when stability is judged. The number of columns disrupted is one: disruption confined to the anterior column tends to indicate stability, while disruption of two or three columns points towards instability. The state of the posterior ligamentous complex is another, and a particularly influential one, because a torn tension band removes a key restraint against the spine bending and collapsing forwards. The degree of kyphotic deformity and of vertebral body height loss, the amount of canal compromise, the extent of comminution, and any translation or rotation of one segment on another all contribute. Finally, the presence and nature of any neurological injury weighs heavily, since neural compromise both reflects the severity of the disruption and raises the stakes of any further movement.

No single measurement settles the question. Stability is judged by integrating the imaging appearances with the clinical and neurological findings, which is exactly what the scoring systems such as TLICS and the AO Spine severity score are designed to formalise.

What the evidence shows about management (non-operative vs surgery) — impersonal

The literature on how thoracolumbar fractures are managed is best summarised impersonally, as a description of what has been found rather than as guidance for any individual.

For the milder, clearly stable end of the spectrum, the established position in the literature is that injuries such as wedge compression fractures with an intact posterior ligamentous complex and no neurological deficit are generally managed without surgery, often with a period of bracing and graded mobilisation. For the severe end of the spectrum, the literature is equally consistent in the other direction: unstable patterns such as fracture-dislocations, and injuries with significant neurological compression, are generally treated surgically, with the aims of realigning and stabilising the spine and relieving pressure on the nervous tissue.

The genuine area of debate sits in the middle, with the burst fracture that has no neurological deficit. Here the evidence is mixed. A landmark randomised controlled trial reported by Wood and colleagues in 2003 found no clear advantage for surgery over non-operative treatment in neurologically intact stable burst fractures, with comparable long-term outcomes. A separate randomised trial reported by Siebenga and colleagues in 2006 reached the opposite conclusion, favouring operative treatment. This discordance is precisely why the question was examined in a Cochrane systematic review, published by Abudou and colleagues in 2013, which concluded that the available evidence is insufficient to establish that either approach is clearly superior for neurologically intact stable burst fractures. The honest summary, therefore, is that for this particular group of injuries there is no firm consensus in the literature that surgery improves outcomes, while for unstable injuries and those with neural compression surgery is the generally accepted approach.

Where surgery is undertaken, the broad goals are to restore the alignment of the spine, to stabilise the injured segment so that it can heal, and, where necessary, to decompress the nervous tissue. The choice of surgical approach is informed by the morphology of the injury and by tools such as the load-sharing classification.

Outlook

The outlook after a thoracolumbar fracture varies enormously across the spectrum, which is one of the reasons careful classification matters. At the mild end, stable compression fractures in people with otherwise healthy bone generally heal well, with pain settling over a period of weeks to a few months as the bone consolidates. Burst fractures without neurological injury also generally have a favourable bony outlook, although the recovery of function and the resolution of pain can take longer and depend on the individual injury.

Where neurological injury is present, the outlook is shaped above all by the severity and completeness of that injury. Research relating the level and degree of neural injury to recovery shows that conus and cauda equina injuries, which are characteristic of fractures at this level, have a variable prognosis, and that incomplete injuries generally carry a better outlook for recovery than complete ones. Long-term considerations across the spectrum can include residual or recurrent back pain, some degree of persistent deformity, and, where the nervous tissue was affected, a varying degree of lasting neurological change. Because outcome depends so heavily on the specific pattern, the stability of the injury, the state of the nervous tissue and individual factors such as bone quality and age, the trajectory after a thoracolumbar fracture is best understood as a range rather than a single fixed expectation.
