

Chance Fracture

A patient guide

In brief: A Chance fracture, known more formally as a flexion-distraction injury, is a type of spinal injury in which the spine is pulled apart in tension rather than crushed in compression. It runs along a roughly horizontal line through the back of the spine, most often at the junction between the chest and the lower back, and is classically associated with a lap seat belt acting as a pivot during sudden deceleration. This is why it is sometimes called a seat-belt injury, and why it carries a well-recognised association with injury to the abdomen.

What a Chance fracture is

A Chance fracture is a transverse, or roughly horizontal, failure of the spine. It was first described by the British radiologist G. Q. Chance in 1948, and the name has stayed with this pattern of injury ever since. The defining feature is the direction in which the spine fails: rather than being squashed from above, the spine is stretched and torn apart from behind forwards, along a line that runs across the bones and soft tissues of one spinal level.

The spine can be thought of, in simplified terms, as three columns running from front to back. The front column is made up of the front part of the vertebral body and the disc. The middle column is the back part of the vertebral body. The back, or posterior, column contains the bony arch, the small facet joints and a band of strong ligaments that runs down the back of the spine, often called the posterior ligamentous complex or posterior tension band. In a Chance injury, the back of the spine is placed under tension and fails first, and the line of failure then travels forwards through the middle and frequently the front column as well. The result is an injury that crosses all three columns along a single transverse plane.

These injuries occur most commonly at the thoracolumbar junction, the area spanning roughly the eleventh thoracic to the second lumbar vertebra (T11 to L2). This is the region where the relatively stiff, rib-supported thoracic spine meets the more mobile lumbar spine, so it is a natural point of concentration for bending forces. Within the modern AO Spine classification system, Chance and related flexion-distraction injuries are grouped together as type B injuries, defined by failure of the tension band.

The seat-belt mechanism (tension/distraction)

The classic mechanism is a sudden, forceful forward bend of the trunk over a restraining lap belt. When a vehicle decelerates abruptly, the upper body is thrown forwards while the pelvis is held back by the belt. If the belt sits low across the lap, it acts as a fixed pivot point, or fulcrum, positioned in front of the spine. The trunk folds sharply over this fulcrum.

The consequence of bending over a fulcrum that lies in front of the body is that the back of the spine is stretched. The further a structure sits behind the pivot, the more it is pulled apart. The posterior ligaments, the facet joints and the bony arch are therefore subjected to powerful tension, or distraction, forces and are pulled open. Because the pivot is anterior, much of the spine experiences pulling apart rather than crushing, and the injury propagates forwards as a horizontal split. This is the essence of a flexion-distraction injury: flexion supplies the bending, and distraction describes the spine being lengthened and torn apart along its back.

The link between lap seat belts and this pattern of lumbar injury was set out by Smith and Kaufer in 1969, building on the original radiological description by Chance. The seat belt is, of course, a life-saving device, and the modern three-point belt with its diagonal shoulder strap distributes loads far more safely than an isolated lap belt. The mechanism is best understood as a description of how the injury arises rather than a comment on restraint use, and high-energy falls and other deceleration events can produce the same forces.

Bony, ligamentous and mixed types

Although the mechanism is consistent, the path that the injury takes through the tissues of the spine varies, and this variation matters a great deal. Chance and flexion-distraction injuries are usually described as falling into three groups.

A bony, or transosseous, Chance fracture runs predominantly through bone. The horizontal split travels through the spinous process at the back, through the bony arch and pedicles, and into the back of the vertebral body. In the AO Spine system this corresponds to the B1 subtype. Because bone heals by knitting back together, a bony Chance fracture has the biological capacity to consolidate and unite, much as other fractures do.

A ligamentous, or transligamentous, injury runs predominantly through soft tissues rather than bone. Here the line of failure passes through the posterior ligaments, the capsules of the facet joints and frequently the disc, rather than through the vertebral arch. In the AO Spine system this is broadly the B2 pattern when the disruption is predominantly through soft tissue. The crucial difference is biological: torn ligaments and discs do not reliably heal back to their original strength under load in the way that fractured bone does. For this reason, purely ligamentous variants are generally regarded as the most unstable and the least likely to settle without intervention.

A mixed, or osseoligamentous, injury involves both bone and soft tissue together, and large imaging series suggest this combined pattern is in fact the commonest in real-world practice. One detailed imaging study found a combined bony and soft-tissue injury in the great majority of cases. The practical importance of distinguishing these groups lies in healing potential: an injury that runs through bone can knit, whereas an injury that runs through ligament tends not to, and this single distinction shapes much of how these injuries are understood.

How it differs from a burst fracture

A Chance fracture is often best understood by contrast with a burst fracture, because the two are in many respects mechanical opposites. The distinction is one of the most important points to grasp about this injury.

A burst fracture is caused by axial compression. A load travels down the length of the spine and crushes the vertebral body, which fails by shattering and shortening. Fragments of the broken body can be pushed backwards, sometimes narrowing the spinal canal. The spine, in effect, becomes shorter at the injured level.

A Chance or flexion-distraction injury is caused by the opposite force. Rather than being crushed under a downward load, the spine is pulled apart in tension. Instead of shortening, the injured level is lengthened, or distracted. The pivot lies in front of the spine rather than within the vertebral body, and the failure begins at the back, in the posterior tension band, rather than in the body itself. Where a burst fracture characteristically involves comminution of the vertebral body with possible retropulsion of fragments, a Chance injury characteristically shows a horizontal split with relatively little crushing of the body, unless the patterns are mixed.

This inversion has consequences. In a burst fracture the posterior tension band is often intact, whereas in a Chance injury its disruption is the defining lesion. The two also differ in their typical company: the seat-belt mechanism that produces a Chance injury carries a markedly higher association with abdominal injury than a typical burst fracture. When these injuries are treated surgically, the principles are correspondingly inverse. A distraction injury that has been pulled apart is generally stabilised by applying compression across the back of the spine to close the gap, whereas burst fractures have historically been addressed by supporting or restoring the height of the crushed anterior column. The two injuries are, in a sense, mirror images: one crushed and shortened, the other stretched and lengthened.

The association with abdominal injury (the seat-belt sign)

The single most important association of a Chance injury, beyond the spine itself, is with injury inside the abdomen. The same belt-related forces that fold the trunk over a fulcrum and tear the back of the spine can compress and shear the abdominal contents against the spine and against the belt.

The injuries most characteristically described are to the hollow organs of the bowel, including perforation of the intestine, and tears of the mesentery, the fan of tissue that carries the blood supply to the bowel. These can be present even when external signs are modest. A recognised external warning is the so-called seat-belt sign: a band of bruising or grazing across the lower abdomen in the line of the belt. Its presence has long been understood to raise the suspicion of underlying visceral injury.

The strength of this association is striking in the published literature. Reported rates of associated intra-abdominal injury reach in the region of half of adult cases, and have been reported even higher in children, up to around two-thirds in some paediatric series. Children appear especially vulnerable, in part because their body proportions and the geometry of adult lap belts can place the belt high across the soft abdomen rather than low across the bony pelvis. This is why a Chance injury is rarely considered in isolation, and why imaging of the abdomen sits alongside imaging of the spine in the assessment of these patients.

How it tends to present

A Chance injury typically follows a high-energy event involving sudden deceleration, most classically a road traffic collision, though falls from height and other rapid deceleration events can produce the same forces. Back pain and tenderness at the level of injury are common, and there may be a visible or palpable gap or step in the line of the spinous processes where the back of the spine has been pulled open.

The bruise of the seat-belt sign across the abdomen, where present, is an important external clue both to the mechanism and to the possibility of injury within the abdomen. Some people present with abdominal pain or tenderness that reflects the visceral component rather than the spine. Because the injury can disrupt the spinal canal in mixed patterns, there may in some cases be neurological symptoms such as altered sensation, weakness or disturbance of bladder or bowel function, although many Chance injuries occur without neurological deficit. The combination of a deceleration mechanism, focal back tenderness and abdominal bruising is the classic clinical picture that brings this injury to mind.

How it is assessed (X-ray, CT, MRI for the posterior ligaments)

Imaging is central to recognising and characterising a Chance injury, and each form of imaging contributes something different.

Plain radiographs, or X-rays, can show the horizontal split through a vertebra, an increased distance between adjacent spinous processes where the back of the spine has been pulled apart, and a dissociated appearance of the posterior elements. X-rays are useful for raising the suspicion of the injury, but they tend to under-call soft-tissue damage and can underestimate the true extent of an injury that runs through ligaments.

Computed tomography, or CT, gives detailed pictures of bone and is the workhorse for mapping the bony fracture lines: the transverse split through the pedicles, arch and body. CT is excellent at defining the bony component and the overall alignment, but because it images bone so well and soft tissue less well, it can miss a purely ligamentous disruption in which little bone is broken.

Magnetic resonance imaging, or MRI, is particularly valuable for assessing the soft tissues at the back of the spine: the posterior ligamentous complex, the facet capsules, the disc and the spinal cord itself. On MRI, a disrupted posterior ligamentous complex may show as increased signal, reflecting swelling and bleeding within the torn ligaments. Because the integrity of these posterior ligaments is one of the central questions in characterising a Chance injury, MRI often provides information that neither X-ray nor CT can. Given the strong association with abdominal injury, imaging of the abdomen, usually by CT, commonly accompanies imaging of the spine when the mechanism and clinical picture point towards this pattern of injury.

What the evidence shows about management (bracing vs surgery) — impersonal

The published evidence on managing Chance and flexion-distraction injuries turns largely on two questions: whether the injury runs through bone or through ligament, and whether the back of the spine remains stable. Decisions in any individual case rest with the treating team, and what follows is a description of the evidence rather than guidance.

For selected bony Chance fractures, of the AO B1 type, in which the injury runs through bone, the person has no neurological deficit, the injury is at a single level and the angulation is modest, the literature supports non-operative management in a hyperextension brace or thoracolumbar orthosis. In these circumstances the bone has the capacity to unite, and reported outcomes of bracing have been described as comparable to surgery in suitably selected cases, with reliable bony healing. Commonly cited thresholds in the literature for considering a brace include limited kyphotic angulation and an intact neurological examination.

The picture is generally different where the injury runs predominantly through ligament, or where there is clear disruption of the posterior ligamentous complex, neurological involvement, marked angulation or displacement, injury at more than one level, or a failure to hold the reduction in a brace. Because torn ligaments do not heal as reliably as bone, ligamentous and significant osseoligamentous injuries are highlighted across the literature as poor candidates for bracing, and operative stabilisation is more commonly described. The surgical principle reflects the mechanism: because the spine has been pulled apart, it is generally stabilised by applying compression across the back of the spine, typically with instrumented fixation, to close the gap and restore the tension band. Posterior compression instrumentation is the long-standing standard, and minimally invasive percutaneous techniques have been reported to give comparable results with less blood loss and less soft-tissue disruption in appropriate cases. The recurring theme of the evidence is that the choice between brace and surgery is driven by the tissue involved and the stability of the injury rather than by the label alone.

Outlook

The outlook for a Chance injury depends a great deal on the factors set out above: whether the failure runs through bone or ligament, whether the nerves are involved, and whether the abdomen has been injured alongside the spine. A neurologically intact bony Chance fracture that unites, whether in a brace or after surgery, generally has a favourable prognosis for the spine, because healed bone restores the integrity of the column. Ligamentous injuries, which depend on stabilisation and fusion rather than on natural healing, are the more demanding to manage and are watched for progressive angulation if not adequately addressed.

The associated abdominal injuries can be as significant as the spinal injury itself in the early period, which is why recognition of the seat-belt sign and timely assessment of the abdomen feature so prominently in the literature. Once the early phase is past and any visceral injury has been managed, the long-term outlook for the spine relates principally to whether the injured level has been brought to a stable, healed state. With appropriate stabilisation, whether non-operative or surgical, many people recover well, and the framework of bone-versus-ligament and stable-versus-unstable remains the most useful way to understand the range of outcomes.