Spinal Fractures Classification System
an AOSpine Knowledge Forum initiative

- Cervical Spine Fractures
- Thoracolumbar Spine Fractures
- Sacral Spine Fractures
AOSpine—the leading global academic community for innovative education and research in spine care, inspiring lifelong learning and improving patients’ lives.
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Project members (in alphabetic order)


Endorsed by AOSpine International Board as the official AOSpine Classification.
AOSpine Knowledge Forum

- Cervical Spine Fractures Classification System
## Compression injuries

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>No bony injury or minor injury such as an isolated lamina fracture or spinous process fracture</td>
</tr>
<tr>
<td>A1</td>
<td>Compression fracture involving a single endplate without involvement of the posterior wall of the vertebral body</td>
</tr>
<tr>
<td>A2</td>
<td>Coronal split or pincer fracture involving both endplates without involvement of the posterior wall of the vertebral body</td>
</tr>
<tr>
<td>A3</td>
<td>Burst fracture involving a single endplate with involvement of the posterior vertebral wall</td>
</tr>
<tr>
<td>A4</td>
<td>Burst fracture or sagittal split involving both endplates</td>
</tr>
</tbody>
</table>
### Distraction injuries

<table>
<thead>
<tr>
<th>Type</th>
<th>Subtype</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td><strong>Posterior Tension Band Injury (bony)</strong></td>
<td>Physical separation through fractured bony structures only</td>
</tr>
<tr>
<td>B2</td>
<td><strong>Posterior Tension Band Injury (bony Capsuloligamentous, ligamentous)</strong></td>
<td>Complete disruption of the posterior capsuloligamentous or bony capsuloligamentous structures together with a vertebral body, disk, and/or facet injury</td>
</tr>
<tr>
<td>B3</td>
<td><strong>Anterior Tension Band Injury</strong></td>
<td>Physical disruption or separation of the anterior structures (bone/disk) with tethering of the posterior elements</td>
</tr>
</tbody>
</table>
Translation injuries

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Translational injury in any axis-displacement or translation of one vertebral body relative to another in any direction</td>
</tr>
</tbody>
</table>
## Facet injuries

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Nondisplaced Facet Fracture with fragment &lt;1cm in height, &lt;40% of lateral mass</td>
</tr>
<tr>
<td>F2</td>
<td>Facet fracture with fragment &gt;1cm, &gt; than 40% lateral mass, or displaced</td>
</tr>
<tr>
<td>F3</td>
<td>Floating lateral mass</td>
</tr>
<tr>
<td>F4</td>
<td>Pathologic subluxation or perched/dislocated facet</td>
</tr>
<tr>
<td>BL</td>
<td>Bilateral injury</td>
</tr>
</tbody>
</table>
# Neurology

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Neurologically Intact</td>
</tr>
<tr>
<td>N1</td>
<td>Transient neurologic deficit</td>
</tr>
<tr>
<td>N2</td>
<td>Radiculopathy</td>
</tr>
<tr>
<td>N3</td>
<td>Incomplete spinal cord injury</td>
</tr>
<tr>
<td>N4</td>
<td>Complete spinal cord injury</td>
</tr>
<tr>
<td>NX</td>
<td>Neurological status unknown</td>
</tr>
<tr>
<td>+</td>
<td>Ongoing cord compression in setting of incomplete neurologic deficit or nerve injury</td>
</tr>
</tbody>
</table>
## Modifiers

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Posterior Capsuloligamentous Complex injury without complete disruption</td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td>Critical disk herniation</td>
<td></td>
</tr>
<tr>
<td>M3</td>
<td>Stiffening/metabolic bone disease (ie.: DISH, AS, OPLL, OLF)</td>
<td></td>
</tr>
<tr>
<td>M4</td>
<td>Vertebral artery abnormality</td>
<td></td>
</tr>
</tbody>
</table>
Classification

- Injuries are first classified by their level and primary injury type, either C, B, or A. If there are multiple levels, the most severe level is classified first. The secondary injuries are parenthesized.

For example, a C6-C7 translational injury (C) with a C7 compression fracture (A1) would be classified as:

C6-C7:C
(C7:A1)

And a C5-C6 flexion distraction injury (B2) with a C6 compression fracture (A1) would be classified as:

C5-C6:B2
(C6:A1)
Classification—Facet Injuries

- Included in parenthesis are the remaining subgroups in the order of: facet injuries, neurological status, and any modifiers.

- For bilateral facet injuries, the “BL” modifier is added after the facet injury if the injuries are the same.
  
  For example, a C6-C7 flexion distraction injury (B2) with bilateral facet dislocation (F4) would be classified as:
  
  C6-C7:B2 (F4 BL)

- When there are different facet injuries to the same level, the right side is listed first, then the left.
  
  For example, a C6-C7 flexion distraction injury (B2) with right sided facet dislocation (F4) and a left sided displaced facet fracture (F2) would be classified as:
  
  C6-C7:B2 (F4, F2)

- If there are multiple injuries to the same facet (For example: small fracture (F1) and dislocation (F4), only the highest level facet injury is classified (F4).

- If only facet injuries are identified (No A, B, or C injury), they are listed first after the level of injury.
Type A: Compression injuries

A0. No bony injury or minor injury such as an isolated lamina fracture or spinous process fracture
Type A: Compression injuries

A1. Compression fracture involving a single endplate without involvement of the posterior wall of the vertebral body
Type A: Compression injuries

A1. Compression fracture involving a single endplate without involvement of the posterior wall of the vertebral body
Type A: Compression injuries

A2. Coronal split or pincer fracture involving both endplates without involvement of the posterior wall of the vertebral body
Type A: Compression injuries

A3. Burst fracture involving a single endplate with involvement of the posterior vertebral wall
Type A: Compression injuries

A3. Burst fracture involving a single endplate with involvement of the posterior vertebral wall
Type A: Compression injuries

A4. Burst fracture or sagittal split involving both endplates
Type A: Compression injuries

A4. Burst fracture or sagittal split involving both endplates
Type A: Compression injuries

A4. Burst fracture or sagittal split involving both endplates
Type B: Distraction injuries

B1. Posterior tension band injury (bony)
Type B: Distraction injuries

B2. Posterior tension band injury (bony capsuloligamentous, ligamentous)
Type B: Distraction injuries

B3. Anterior tension band injury
Type C: Translation injuries

C. Translational injury
Facet injuries

F1. Nondisplaced facet fracture
(Fragment <1 cm, < 40% lateral mass)
Facet injuries

**F2.** Facet fracture with fragment >1cm, > 40% lateral mass or displaced
Facet injuries

**F3.** Floating lateral mass
Facet injuries

F4. Pathologic subluxation or perched/dislocated facet
F4. Pathologic subluxation or perched/dislocated facet
Facet injuries

F4. Pathologic subluxation or perched/dislocated facet
Facet injuries

**BL.** Bilateral injury
Case Example 1.
25 year old male involved in high speed MVA, complete SCI

C7-T1: C
(T1:A1; F4 BL; N4)

(assume bilateral)
**Case Example 1.**
25 year old male involved in high speed MVA, complete SCI

C7-T1: C (T1:A1; F4 BL; N4)  |  Translational injury (C), with compression fracture at T1 (A1), bilateral facet dislocations (F4 BL), complete SCI (N4)

(assume bilateral)
Case Example 2.
42 year old male involved in high speed MVA, radiculopathy

C5: F2, C6: F2
(N2; M1)
**Case Example 2.**
42 year old male involved in high speed MVA, radiculopathy

C5: F2, C6: F2 (N2; M1)  
C5 and C6 displaced facet fractures (F2), radiculopathy (N2), posterior capsuloligamentous complex injury without complete disruption (M1)
Thoracolumbar Spine Fractures Classification System
Thoracolumbar Fractures—Overview

This classification and injury severity system is based on the evaluation of three basic parameters:

1. **Morphologic classification of the fracture**
2. **Neurologic injury**
3. **Clinical modifiers**
1. Morphologic classification

This is based on the Magerl classification modified by the AOSpine Classification Group. For this evaluation radiograms and CT scans with multiplanar reconstructions are essential. In some cases additional MR images might be necessary. Three basic types are identified on the basis of the mode of failure of the spinal column:

- **Type A:** Compression injuries. Failure of anterior structures under compression.
- **Type B:** Failure of the posterior or anterior tension band.
- **Type C:** Failure of all elements leading to dislocation or displacement.
### Type A

Describe injury to the vertebral body without tension band (PLC) involvement. There are five subtypes and no further sub-classification. These subtypes are also used as description of vertebral body fracture in B and C Types.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td><strong>Minor, nonstructural fractures</strong> Fractures, which do not compromise the structural integrity of the spinal column such as transverse process or spinous process fractures.</td>
</tr>
<tr>
<td>A1</td>
<td><strong>Wedge-compression</strong> Fracture of a single endplate without involvement of the posterior wall of the vertebral body.</td>
</tr>
<tr>
<td>A2</td>
<td><strong>Split</strong> Fracture of both endplates without involvement of the posterior wall of the vertebral body.</td>
</tr>
<tr>
<td>A3</td>
<td><strong>Incomplete burst</strong> Fracture with any involvement of the posterior wall; only a single endplate fractured. Vertical fracture of the lamina is usually present and does not constitute a tension band failure.</td>
</tr>
<tr>
<td>A4</td>
<td><strong>Complete burst</strong> Fracture with any involvement of the posterior wall and both endplates. Vertical fracture of the lamina is usually present and does not constitute a tension band failure.</td>
</tr>
</tbody>
</table>
Type B

Describe the failure of posterior or anterior constraints (in case of TL this is the tension band or PLC / Posterior Ligamentary Complex or the anterior longitudinal ligament).
Is to be combined with subtypes A when appropriate. There are three subtypes:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>Monosegmental pure osseous failure of the posterior tension band. The classical Chance fracture.</td>
</tr>
<tr>
<td>B2</td>
<td>Bony and/or ligamentary failure of the posterior tension band together with a Type A fracture. Type A fracture should be classified separately.</td>
</tr>
<tr>
<td>B3</td>
<td>Injury through the disk or vertebral body leading to a hyperextended position of the spinal column. Commonly seen in ankylosic disorders. Anterior structures, especially the ALL are ruptured but there is a posterior hinge preventing further displacement.</td>
</tr>
</tbody>
</table>
Type C

Describe displacement or dislocation. There are no subtypes as because of the dissociation between cranial and caudal segments various configurations are possible in different images. Is combined with subtypes of A if necessary.
**Type A**

**AO.** Minor, nonstructural fractures
Fractures, which do not compromise the structural integrity of the spinal column such as transverse process or spinous process fractures.
A1. **Wedge-compression**
Fracture of a single endplate without involvement of the posterior wall of the vertebral body.
Type A

A2. Split
Fracture of both endplates without involvement of the posterior wall of the vertebral body.
Type A

A3. Incomplete burst
Fracture with any involvement of the posterior wall; only a single endplate fractured. Vertical fracture of the lamina is usually present and does not constitute a tension band failure.
A4. Complete burst
Fracture with any involvement of the posterior wall and both endplates. Vertical fracture of the lamina is usually present and does not constitute a tension band failure.
**Type B**

**B1. Transosseous tension band disruption / Chance fracture**

Monosegmental pure osseous failure of the posterior tension band. The classical Chance fracture.
Type B

B2. Posterior tension band disruption
Bony and/or ligamentary failure of the posterior tension band together with a Type A fracture. Type A fracture should be classified separately.

Example: This should be classified as: T12-L1 Type B2 with T12 A4 according to the combination rules.
Type B

B3. Hyperextension
Injury through the disk or vertebral body leading to a hyperextended position of the spinal column. Commonly seen in ankylosis disorders. Anterior structures, especially the ALL are ruptured but there is a posterior hinge preventing further displacement.
Type C

C. Displacement or dislocation
There are no subtypes as because of the dissociation between cranial and caudal segments various configurations are possible in different images. Is combined with subtypes of A if necessary.
Algorithm for morphologic classification

START → Displacement/Dislocation → Yes → C Translation

No

Tension band injury → Yes

Anterior → Osseoligamentous disruption → Yes → B3 Hyperextension

Posterior → Mono-segmental osseous disruption → Yes → B2 Osseoligamentous disruption

No

Vertebral body fracture → Yes

Both endplates involved → Yes → A4 Complete burst

Posterior wall involvement → Yes → A3 Incomplete burst

No → Both endplates involved → Yes → A2 Split/Pincer

No

Vertebral process fracture → Yes → A1 Wedge/Impaction

No → No injury → A0 Insignificant injury
2. Neurologic injury

Neurologic status at the moment of admission should be scored according to the following scheme:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N0</td>
<td>Neurologically intact</td>
</tr>
<tr>
<td>N1</td>
<td>Transient neurologic deficit, which is no longer present</td>
</tr>
<tr>
<td>N2</td>
<td>Radicular symptoms</td>
</tr>
<tr>
<td>N3</td>
<td>Incomplete spinal cord injury or any degree of cauda equina injury</td>
</tr>
<tr>
<td>N4</td>
<td>Complete spinal cord injury</td>
</tr>
<tr>
<td>NX</td>
<td>Neurologic status is unknown due to sedation or head injury</td>
</tr>
</tbody>
</table>
3. Modifiers

There are two modifiers, which can be used in addition to ad 1 and 2:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>This modifier is used to designate fractures with an indeterminate injury to the tension band based on spinal imaging with or without MRI. This modifier is important for designating those injuries with stable injuries from a bony standpoint for which ligamentous insufficiency may help determine whether operative stabilization is a consideration.</td>
</tr>
<tr>
<td>M2</td>
<td>Is used to designate a patient-specific comorbidity, which might argue either for or against surgery for patients with relative surgical indications. Examples of an M2 modifier include ankylosing spondylitis or burns affecting the skin overlying the injured spine.</td>
</tr>
</tbody>
</table>
Sacral Spine Fractures Classification System
Sacral Fractures—Overview

- **Hierarchical system progressing from least to most unstable**

- **Type A.** Lower Sacro-coccygeal Injuries
  No impact on posterior pelvic or spino-pelvic instability

- **Type B.** Posterior Pelvic Injuries
  Minimal to no impact on spino-pelvic stability

- **Type C.** Spino-Pelvic Injuries
  Spino-pelvic instability
Type A: Sacrocccygeal Fractures

**Definition:**
- Injuries below the S-I joint
- No impact on posterior pelvic stability
- No impact on spino-pelvic stability
- *May* have impact on neurology

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Coccygeal or sacral compression vs ligamentous avulsion fractures</td>
</tr>
<tr>
<td>A2</td>
<td>Nondisplaced transverse injuries below S-I joint</td>
</tr>
<tr>
<td></td>
<td>Usually neuro intact</td>
</tr>
<tr>
<td>A3</td>
<td>Displaced transverse injuries below S-I joint</td>
</tr>
<tr>
<td></td>
<td>Often have cauda equina injuries</td>
</tr>
</tbody>
</table>
Type B: Posterior Pelvic Injuries

**Definition:**
- Unilateral longitudinal sacral fractures
- Primary impact is on posterior pelvic stability
- Minimal to no impact on spino-pelvic stability* (*Except B4 – Injuries extending into facet)
- Framework is variation of Denis Zones I through III injuries
- Usually treated with sacroiliac screw fixation

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
</table>
| B1   | **Central** Fracture that involves spinal canal, but with primarily longitudinal fracture pattern  
- **Longitudinal** injuries only – rare type of Denis Zone III injuries  
- Does not have the same impact on spino-pelvic stability nor same propensity for cauda equina injury as transverse fxs involving canal  
- Very low likelihood of neurological injury |
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
</table>
| B2   | • **Transalar** fracture: Does not involve foramina or spinal canal  
• Denis Zone I injury  
• Approx 5% chance of neuro injury |
| B3   | • **Transforaminal** fracture: Involves foramina but not spinal canal  
• Denis Zone II injury  
• Approx 25% chance of neuro injury |
| B4   | • **Any** unilateral B-subtype that involves fracture of ipsilateral L5-S1 facet joint  
• MAY IMPACT SPINO-PELVIC STABILITY (Isler), thus potentially most unstable of B-subtypes |
# Type C: Spino-Pelvic Injuries

**Definition:**
- Injuries resulting in spino-pelvic instability

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
</table>
| C1   | - Nondisplaced sacral U-type fracture  
     - Commonly seen as low-energy insufficiency fracture |
| C2   | - Bilateral Type B injuries without transverse fx  
     - More unstable and higher likelihood of neuro injury than C1, but lower than C3 |
| C3   | - Displaced sacral U-type sacral fracture  
     - Worst combination of instability and likelihood of neuro injury  
     - Displaced transverse sacral fx = canal compromise |
Type A: Sacrococcygeal Fractures

A1. Coccygeal or compression vs ligamentous avulsion fractures
Type A: Sacroccygeal Fractures

A2. Non-displaced transverse fractures below the S-I joint
   • No implications on stability
   • Low likelihood of cauda equina injury
**Type A: Sacroccygeal Fractures**

**A3.** Displaced transverse fractures below the S-I joint
- Higher likelihood of neuro injury than A1 or A2
- May possibly benefit from reduction & stabilization
Type B: Posterior Pelvic Injuries

B1. Central Fracture
  • Rare type of Denis Zone III injury—primary longitudinal pattern only
Type B: Posterior Pelvic Injuries

B2. Transalar Fracture
• 5% chance of neurological injury (primarily L5)
Type B: Posterior Pelvic Injuries

**B3. Transforaminal Fracture**
- Approx 25% chance of neuro injury
**Type B: Posterior Pelvic Injuries**

**B4.** Any Unilateral B-subtype that involves L5-S1 facet joint
- Usually B3
- May impact spino-pelvic stability (Isler)
Type C: Spino-Pelvic Injuries

C1. Nondisplaced sacral U-type variant
   • Commonly seen low-energy insufficiency fracture
Type C: Spino-Pelvic Injuries

C1. (alternative)

Sacral U-type variant without posterior pelvic instability
• Either displaced or non-displaced
• Spino-pelvic instability without posterior pelvic instability
Type C: Spino-Pelvic Injuries

C2. Bilateral Type B injuries without transverse fracture
   • More unstable and higher likelihood of neuro injury than C1
Type C: Spino-Pelvic Injuries

C3. Displaced U-type sacral fracture
• Similar instability profile to C2, but higher likelihood of neuro injury due to transverse fracture displacement & canal compromise
Advancing spine care worldwide

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