Spinal Fractures Classification System
an AOSpine Knowledge Forum initiative

- Subaxial 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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AOSpine Knowledge Forum

AOSpine Classification and Injury Severity System for Traumatic Fractures of the Subaxial Spine

This is the present form of the classification the AOSpine Knowledge Forum (KF) SCI & Trauma is working on. It is the aim of the KF to develop a system, which can in the future be used as a tool for scientific research and a guide for treatment. This system is being subjected to a rigorous scientific assessment.

Project members
(in alphabetic order)


Disclaimer


2. International validation process to be completed in 2015.

3. Submitted to AOSpine International Board for endorsement as the official AOSpine TL Fractures Classification.
## Compression injuries

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A0</strong></td>
<td>Minor, nonstructural fractures</td>
</tr>
<tr>
<td><strong>A1</strong></td>
<td>Wedge-compression</td>
</tr>
<tr>
<td><strong>A2</strong></td>
<td>Split</td>
</tr>
<tr>
<td><strong>A3</strong></td>
<td>Incomplete burst</td>
</tr>
<tr>
<td><strong>A4</strong></td>
<td>Complete burst</td>
</tr>
</tbody>
</table>
## Tension band injuries

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td><strong>Posterior tension band injury (bony)</strong>&lt;br&gt;Physical separation through fractured bony structures only.</td>
</tr>
<tr>
<td>B2</td>
<td><strong>Posterior tension band injury (bony capsuloligamentous, ligamentous)</strong>&lt;br&gt;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>&lt;br&gt;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>

Bilateral injuries

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL</td>
<td>Bilateral injury</td>
</tr>
</tbody>
</table>
## Facet injuries

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td><strong>Nondisplaced facet fracture</strong></td>
</tr>
<tr>
<td></td>
<td>With fragment $&lt;1 \text{cm}$ in height, $&lt;40%$ of lateral mass.</td>
</tr>
<tr>
<td>F2</td>
<td><strong>Facet fracture with potential for instability</strong></td>
</tr>
<tr>
<td></td>
<td>With fragment $&gt;1 \text{cm}$, $&gt;40%$ lateral mass, or displaced.</td>
</tr>
<tr>
<td>F3</td>
<td><strong>Floating lateral mass</strong></td>
</tr>
<tr>
<td>F4</td>
<td><strong>Pathologic subluxation or perched/dislocated facet</strong></td>
</tr>
</tbody>
</table>

---

*Subaxial Spine Fractures Classification System*
Neurological status modifier

- 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, resolved</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>Cannot be examined</td>
</tr>
</tbody>
</table>
## Case-specific modifiers

- There are four 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>Posterior capsuloligamentous complex injury without complete disruption</td>
</tr>
<tr>
<td>M2</td>
<td>Critical disk herniation</td>
</tr>
<tr>
<td>M3</td>
<td>Stiffening/metabolic bone disease (ie.: DISH, AS, OPLL, OLF)</td>
</tr>
<tr>
<td>M4</td>
<td>Vertebral artery abnormality</td>
</tr>
</tbody>
</table>
Classification nomenclature

- 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:

  \[ \text{C6-C7:B2 (F4 BL)} \]

- 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:

  \[ \text{C6-C7:B2 (F4, F2)} \]

- 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. Minor, nonstructural fractures**

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

A1. Wedge-compression

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

A1. Wedge-compression

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

A2. Split

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

A3. Incomplete burst

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

A3. Incomplete burst

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

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

A4. Complete burst

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

A4. Complete burst

- Burst fracture or sagittal split involving both endplates.
Type B: Tension band injuries

B1. Posterior tension band injury (bony)
- Physical separation through fractured bony structures only.
Type B: Tension band injuries

**B2.** Posterior tension band injury (bony capsuloligamentous, ligamentous)

- Complete disruption of the posterior capsuloligamentous or bony capsuloligamentous structures together with a vertebral body, disk, and/or facet injury.
Type B: Tension band injuries

B3. Anterior tension band injury

- Physical disruption or separation of the anterior structures (bone/disk) with tethering of the posterior elements.
Type C: Translation injuries

**C.** Translational injury in any axis-displacement or translation of one vertebral body relative to another in any direction
Bilateral injuries

BL. Bilateral injury
Facet injuries

**F1. Nondisplaced facet fracture**
- With fragment <1 cm in height, <40% of lateral mass.
Facet injuries

**F2.** Facet fracture with potential for instability

- With fragment >1cm, > than 40% lateral mass, or displaced.
Facet injuries

F3. Floating lateral mass
Facet injuries

F4. Pathologic subluxation or perched/dislocated facet
Facet injuries

F4. Pathologic subluxation or perched/dislocated facet
Facet injuries

**F4.** Pathologic subluxation or perched/dislocated facet
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)
AOSpine Knowledge Forum

AOSpine Classification and Injury Severity System for Traumatic Fractures of the Thoracolumbar Spine

This is the present form of the classification and injury severity system the AOSpine Knowledge Forum (KF) SCI & Trauma is working on. It is the aim of the KF to develop a system, which can in the future be used as a tool for scientific research and a guide for treatment. This system is being subjected to a rigorous scientific assessment.


Disclaimer


3. Submitted to AOSpine International Board for endorsement as the official AOSpine TL Fractures Classification
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><strong>A0</strong></td>
<td>Minor, nonstructural fractures</td>
</tr>
<tr>
<td><strong>A1</strong></td>
<td>Wedge-compression</td>
</tr>
<tr>
<td><strong>A2</strong></td>
<td>Split</td>
</tr>
<tr>
<td><strong>A3</strong></td>
<td>Incomplete burst</td>
</tr>
<tr>
<td><strong>A4</strong></td>
<td>Complete burst</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>Transosseous tension band disruption / Chance fracture</td>
</tr>
<tr>
<td>B2</td>
<td>Posterior tension band disruption</td>
</tr>
<tr>
<td>B3</td>
<td>Hyperextension</td>
</tr>
</tbody>
</table>

- **B1**: Transosseous tension band disruption / Chance fracture
  - Monosegmental pure osseous failure of the posterior tension band.
  - The classical Chance fracture.

- **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.

- **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

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.
Type A

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.
Type A

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

B 1. 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 ankylotic 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

No

Posterior wall involvement

Yes

A3 Incomplete burst

No

A2 Split/Pincer

Vertebral process fracture

Yes

A1 Wedge/Impaction

No

Both endplates involved

No

A0 Insignificant injury

No 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>
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AOSpine Classification and Injury Severity System for Traumatic Fractures of the Sacral Spine

Project members
(in alphabetic order)

Disclaimer

1. Xxxx
Sacral Fractures: Overview

- Pelvic Ring Fractures (Tile, Letournel, AO)
- Lumbosacral Dislocation (Isler)
- Sacral Fractures (Denis, Roy-Camille)
Implications on Prognosis & Treatment

- **Degree of instability**
  - Broadly correlated with:
    - Energy of injury
    - Amount of displacement

- **Type of instability**
  - Location of fracture:
    - Lower sacrum (no pelvic or spino-pelvic involvement)
    - Posterior pelvic
    - Spino-pelvic
    - Both posterior pelvic & spino-pelvic

- **Neurological injury**
  - Broadly correlated with:
    - Energy of injury
    - Amount of displacement
Sacral Fractures—Overview

- Hierarchical system progressing from least to most unstable

- **Type A.** Lower Sacrococcygeal Injuries
  - NO IMPACT ON POSTERIOR PELVIC OR SPINO-PELVIC INSTABILITY
  - Eg. Compression/avulsion fractures/injuries below sacroiliac joints
  - *Higher grade subtypes may be associated with neuro injury

- **Type B.** Posterior Pelvic Injuries
  - PRIMARY IMPACT IS ON POSTERIOR PELVIC STABILITY
  - Unilateral longitudinal (vertical) sacral fractures
  - No impact on spino-pelvic stability
  - Framework is a variation of Denis Zones I through III injuries

- **Type C.** Spino-Pelvic Injuries
  - SPINO-PELVIC INSTABILITY
  - +/- posterior pelvic instability
  - L5-S1 facet involvement, Sacral U variants, bilat longitudinal injuries
  - Subtype severity based on instability & likelihood of neuro injury
Type A–Sacrococcygeal Injuries

- **Definition:**
  - Injuries below the S-I joint (usually S2)
  - No impact on posterior pelvic or spino-pelvic instability
  - *May* have impact on neurology

- **Type A1**
  - Coccygeal or compression vs ligamentous avulsion fractures

- **Type A2**
  - Non-displaced transverse fractures below the S-I joint

- **Type A3**
  - Displaced transverse fractures below the S-I joint
Type A

A1. Coccygeal or compression vs ligamentous avulsion fractures
Type A

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

A3. Displaced transverse fractures below the S-I joint
- Higher likelihood of neuro injury than A1 or A2 (displacement)
- May possibly benefit from reduction & stabilization
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
- Framework is variation of Denis Zones I through III injuries
- Usually treated with sacroiliac screw fixation

Type B1
- **Central fracture**: Involves spinal canal, but with primarily longitudinal fracture pattern

Type B2
- **Transalar fracture**: Does not involve foramina or spinal canal

Type B3
- **Transforaminal fracture**: Involves foramina but not spinal canal
Type B

B1. Central fracture

- **Longitudinal** injuries only—rare type of Denis Zone III injuries
- Low likelihood of neurological injury
Type B

B2. Transalar fracture (may extend into the SI joint)
- Unilateral Denis Zone I injury
Type B

**B3. Transforaminal fracture**
- Denis Zone II injury
Type C–Spino-Pelvic Injuries

- Definition:
  - Injuries resulting in spino-pelvic instability

- Type C0
  - Nondisplaced sacral U-type variant

- Type C1
  - Alternative–Sacral U-type variant without posterior pelvic instability

- Type C2
  - Bilateral complete Type B injuries without transverse fracture

- Type C3
  - Displaced U-type sacral fracture
Type C

**C0.** Nondisplaced sacral U-type variant

- Commonly seen low-energy insufficiency fracture
Type C

C1. Alternative—Sacral U-type variant without posterior pelvic instability

- Any unilateral B-subtype where ipsilateral superior S1 facet is discontinuous with medial part of sacrum
- May impact spino-pelvic stability (Isler)
Type C

C2. Bilateral complete Type B injuries without transverse fracture

- More unstable and higher likelihood of neuro injury than C1
Type C

C3. Displaced U-type sacral fracture

- Worst combination of instability and likelihood of neuro injury
- Displaced transverse sacral fracture = canal compromise
## Neurology

<table>
<thead>
<tr>
<th>Type</th>
<th>Neurological</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nx</td>
<td>Cannot be examined</td>
</tr>
<tr>
<td>NO</td>
<td>No neurological deficits</td>
</tr>
<tr>
<td>N1</td>
<td>Transient neurological injury</td>
</tr>
<tr>
<td>N2</td>
<td>Nerve root injury</td>
</tr>
<tr>
<td>N3</td>
<td>Cauda Equina Syndrome/Incomplete SCI</td>
</tr>
<tr>
<td>N4</td>
<td>Complete SCI</td>
</tr>
</tbody>
</table>
## Modifiers

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Soft tissue injury</td>
</tr>
<tr>
<td>M2</td>
<td>Metabolic bone disease</td>
</tr>
<tr>
<td>M3</td>
<td>Anterior pelvic ring injury</td>
</tr>
<tr>
<td>M4</td>
<td>Sacroiliac joint injury</td>
</tr>
</tbody>
</table>
Classification nomenclature

Transforaminal fracture (B3) high energy injury associated with anterior pelvic ring (M1) and soft tissue injury (M3)

Primary injury → B3; M1, M3 → Neurologic status and modifiers
Summary

- Morphological basis for new AOSpine sacral fracture classification
- Neurological Exam
- Modifiers for situations that impact treatment or prognosis

Further information: www.aospine.org/classification