McAfee classification

McAfee's classification of acute traumatic spinal injuries is based on the three-column concept of the spine. CT is needed for an accurate assessment.

The McAfee classification describes 6 main types of fractures [1]. A simplified system with four categories follows

Type 1: Compression fracture. Compression failure of the anterior column only. Middle column intact (unlike the 3 other major injuries below) acting as a fulcrum

1. 2 subtypes:

a) anterior: most common between T6–8 and T12–3

● lateral X-ray: wedging of the VB anteriorly, no loss of height of posterior VB, no subluxation

● CT: spinal canal intact. Disruption of anterior endplate

b) lateral(rare)

2. clinical: no neurologic deficit

Type 2: Burst fracture. Pure axial load → compression of vertebral body → compression failure of anterior and middle columns. Occur mainly at TL junction, usually between T10 and L2

1. 5 subtypes; L5 burst fractures may constitute a rare subtype

a) fracture of both endplates: seen in the lower lumbar region(where axial load→increased extension, unlike T-spine where axial load → flexion)

b) fracture of superior endplate: the most common burst fracture. Seen at TL junction. Mechanism = axial load + flexion

c) fracture of inferior endplate: rare

d) burst rotation:usually midlumbar. Mechanism=axial load+rotation

e) burst lateral flexion:mechanism=axial load+lateral flexion

2. radiographic evaluation

a) lateral X-ray: cortical fracture of posterior VB wall, loss of posterior VB height,retropulsion of bone fragment from endplate(s) into the canal

b) APX-ray: increase of interpediculate distance(IPD), vertical fracture of lamina, splaying of facet joints: ↑ IPD indicates a failure of the middle column

c) CT: demonstrates break in the posterior wall of VB with retropulsed bone in the spinal canal (average: 50% obstruction of canal area), increase in IPD with splaying of posterior arch (including facets)

d) MRI: compromise of the anterior canal by bone fragment; possible cord compression usually with fragments occupying > 50% of the canal diameter

e) MRI or myelogram:compression in spinal canal

clinical: depends on the level (thoracic cord more sensitive and less room in the canal than conus region), the impact at the time of disruption, and the extent of canal obstruction

a) ≈50% intact at initial examination(half of these recalled leg numbness, tingling, and/or weakness initially after the trauma that subsided)

b) of patients with deficits, only 5% had complete paraplegia

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Type 3: Seat belt fracture. Flexion across a fulcrum anterior to the anterior column (e.g. seat belt) → compression of anterior column & distraction failure of both middle and posterior columns. Maybe bony or ligamentous. A flexion-distraction fracture (that term is also used for a subtype of fracture-dislocation)

1. 4 subtypes

a) Chance fracture (first desribed by George Quentin Chance [2)]): horizontal fracture, classically one level, purely through bone, splitting the spinous process, laminae, pedicles, and VB

b) one level, through ligaments

c) two-level, through bone in the middle column, through ligament in anterior and posterior columns

d) two-level, through ligament in all 3 columns

2. radiographic evaluation

a) plain X-ray:↑interspinous distance,pars interarticularis fractures, and horizontal split of pedicles and transverse process. No subluxation b) CT:axial cuts are poor for this type (most of fracture is in the plane of axial CT cuts). Sagittal and coronal reconstructions demonstrate well. May demonstrate pars fracture

3. clinical: no neurologic deficit

Type 4: Fracture-dislocation. Failure of all 3 columns due to compression, tension, rotation or shear → subluxation or dislocation

1. X-ray: occasionally, may be reduced when imaged. Look for other markers of significant trauma (multiple rib fractures, unilateral articular process fractures, spinous process fractures, horizontal laminar fractures)

2. 3 subtypes

a) flexion rotation: posterior and middle columns totally ruptured, anteriorly compressed→ anterior wedging

● lateral X-ray: subluxation or dislocation. Preserved posterior VB wall. Increased interspinous distance

● CT: rotation and offset of VBs with → canal diameter. Jumped facets

● clinical: 25% neurologically intact. 50% of those with deficits were complete paraplegics

b) shear:all 3columns disrupted (including ALL)

● when trauma force-directed posteriorly to anteriorly (more common) VB above shears forward fracturing the posterior arch (→ free-floating lamina) and the superior facet of the inferior vertebra

● clinical: all 7 cases were complete paraplegics

c) flexion-distraction

● radiographically resemble seat belt type with the addition of subluxation, or with compression of anterior column > 10–20%

● clinical: neurologic deficit (incomplete in 3 cases, complete in 1)

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wedge compression: isolated anterior column compression

stable burst: anterior and middle column compression but posterior column is normal

unstable burst: anterior and middle column compression with disrupted posterior column

flexion-distraction

anterior column compression

middle and posterior column: tensile failure

axis of flexion: posterior to anterior longitudinal ligament

chance fractures

pure bony injuries that extend all the way through the spinal column: from posterior to anterior through the spinous process, pedicles, and vertebral body, respectively

axis of flexion: anterior to anterior longitudinal ligament

translational fractures

shear force to all the 3 columns [3].

[1]
Chedid MK, Green C. A Review of the Management of Lumbar Fractures With Focus on Surgical Decision-Making and Techniques. Contemp Neurosurg. 1999; 21:1–5

[2]

Chance GQ. Note on a type of flexion fracture of the spine. Br J Radiol. 1948; 21. DOI: 10.1259/0007-128 5-21-249-452

[3]

Mcafee PC, Yuan HA, Fredrickson BE et-al. The value of computed tomography in thoracolumbar fractures. An analysis of one hundred consecutive cases and a new classification. J Bone Joint Surg Am. 1983;65 (4): 461-73. J Bone Joint Surg Am