Traumatic Spondylolisthesis of the Axis (aka Hangman’s Fracture):

Carlo Bellabarba, MD
Professor
Department of Orthopaedics & Sports Medicine
Department of Neurological Surgery
University of Washington School of Medicine
Acting Chief of Orthopaedics
Harborview Medical Center
Seattle, WA

- **Demographics:**
  - 5% of all C-spine fractures
  - Bimodal distribution
    - High energy injuries in younger patients
    - Low energy injuries in elderly patients

- **Classification**
  - Effendi Classification, modified by Levine & Edwards
  - 5 types described
    - 3 primary types
    - 2 subtypes
  - **Primary**
    - Type I:
      - Minimally displaced (≤3mm)
      - Confirm with upright x-rays to distinguish from Type II
    - Type II:
      - Hyperextension mechanism causes pincer effect & vertical pars fracture
      - Disruption of PLL resulting in >3mm of subluxation
      - Most common type
    - Type III:
      - Associated C2-3 facet dislocation
        - Either unilateral or bilateral
        - Behaves more like subaxial jumped facet injury
          - Risk of neurological injury
        - C2 pars fracture component usually non- or minimally displaced (Type I)
  - **Subtypes:**
    - Type IA (Atypical)
      - Catch-all category with range of fracture patterns
        - Typically oblique transverse plane fracture through C2 pars & body on opposite sides
Risk of neurological Injury
  - May behave unpredictably with nonoperative treatment

Type IIA
  - Flexion-distraction injury pattern
  - Kyphotic angulation out of proportion with degree of translation
    - Extent has never been specifically defined
  - Fracture component generally more transverse than Type II

Evaluation:
  - Radiographic:
    - Plain radiographs
      - False negative rate as high as 40%
      - Upright radiographs may help distinguish stability (eg Type I vs Type II)
    - CT scan most reliable
      - Associated injuries
      - Vertebral artery foramen involvement
    - MRI role uncertain
      - C2-3 disc disruption
      - Associated ligamentous injury
    - CTA/MRA
      - Controversial
        - VAI reported in up to ~25% of patients
          - Distractive injuries & fxs involving vertebral foramina
          - Significance?
  - Clinical:
    - Neurological injuries uncommon with Hangman’s fractures
      - Injury patterns that cause canal compromise represent highest risk:
        - Type III injuries (associated facet dislocation)
        - Type 1A (atypical) fractures - asymmetric body/pars fracture
        - Type II injuries with severe anterolisthesis
          - Compression caused by posterior C1 arch

Treatment:
  - Contingent on:
    - Fracture type
    - Neurological exam
    - Associated spine injuries
    - Associated non-spine injuries
  - ~3/4 of all Hangman’s fractures treated nonoperatively
    - Types I & II usually treated nonoperatively
    - Types IIA & III usually treated operatively
    - Type IA (atypical) more difficult to categorize as op vs nonop
Nonoperative treatment generally with rigid cervical collar vs halo-vest
Operative treatment generally C2-3 ACDF vs C2-3 PSIF vs C1-3 PSIF
  - C1-3 PSIF less favorable due to loss of C1-2 motion
  - Direct pars repair controversial
Type I:
  - Confirm with upright radiographs in rigid collar
    - Role of flexion-extension radiographs controversial
  - Treat with rigid cervical collar for 6-12 weeks
Type II:
  - Vast majority can be treated nonoperatively
    - Halo-vest vs rigid cervical collar
      - More displaced injuries may require initial reduction with skeletal traction
    - Bony healing may occur at pars fracture or across C2-3 disc
    - Indications for operative intervention:
      - Polytrauma
      - Neurological Injury
      - Associated ligamentous injury
      - Multifocal spine injuries
      - Failure of conservative treatment
      - Inability to tolerate external immobilization
      - Surgical Options:
        - C2-3 ACDF*
        - C2-3 PSIF
        - C1-3 PSIF
Type III:
  - Requires operative intervention
  - Usually open posterior reduction and C2-3 PSIF
    - May require C1-3 PSIF if C2 fixation unacceptable
    - C2-3 ACDF may be useful in unusual situations
Type 1A (atypical):
  - Behaves unpredictably
  - Can usually be treated nonoperatively
    - Rigid cervical collar vs halo-vest
  - Higher likelihood of failure of nonoperative treatment than for Type I or II injuries
  - Indications for operative intervention:
    - Polytrauma
    - Neurological Injury
    - Associated ligamentous injury
    - Multifocal spine injuries
- Failure of conservative treatment
- Inability to tolerate external immobilization

**Surgical Options:**
- C2-3 ACDF*
- C2-3 PSIF
- C1-3 PSIF

- **Type IIA:**
  - Avoid traction - will worsen deformity
  - Require operative intervention
    - C2-3 ACDF*
    - C2-3 PSIF
    - C1-3 PSIF

**Complications:**
- Missed injuries
  - Elderly patients
  - Low energy injuries
- Fracture displacement/failure of nonoperative treatment
- Nonunion
- Malunion
- Arthritis (C2 lateral mass or inferior facet involvement)
- Loss of motion
- Pain
- Halo-related complications
  - Pin tract infections
  - Scarring
  - Decubiti
  - *age-related
- Perioperative
  - Posterior
    - Infection
    - Neurovascular injury
      - Vertebral artery
    - Nonunion
    - Malalignment
    - Failure of fixation
  - Anterior
    - Malalignment
    - Oropharyngeal injury
    - Neurovascular injury
      - Hypoglossal nerve
    - Dysphagia
• Dysphonia
• Airway compromise
  o Higher risk with upper cervical exposures

• Outcomes:
  o Generally considered favorable, particularly in absence of neuro deficits
  o Paucity of literature
  o ~3/4 anticipated to be pain free without restricted motion at one year.

• References: