Odontoid Fracture

Dr. Nidal Abuhadrous MD, MRCS, ABHS(NS)
Consultant Neurosurgeon
Head of Neurosurgery – Nasser Medical Complex

Odontoid Fracture

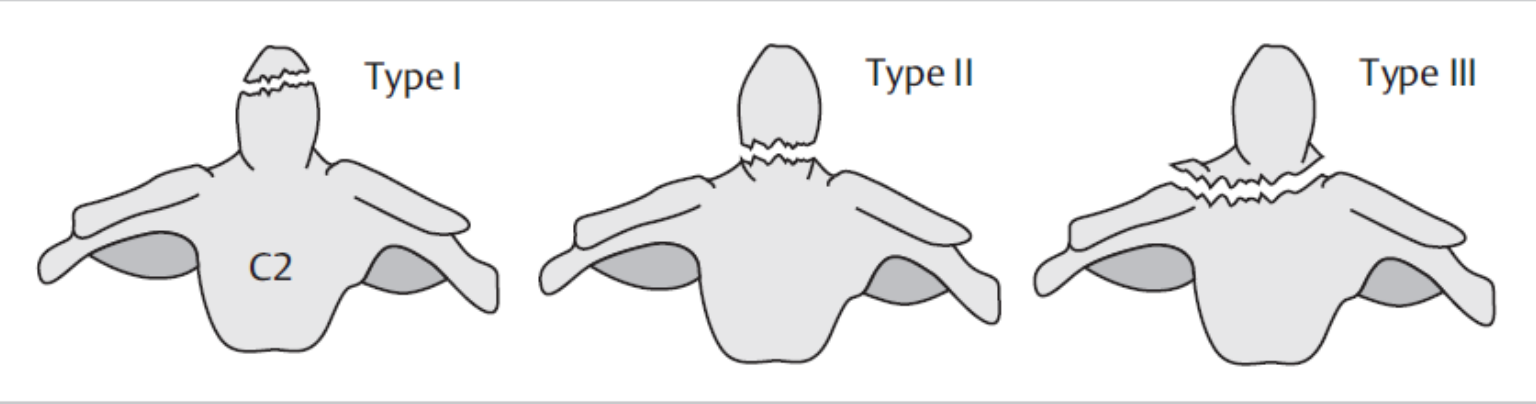
- 10–15% of C-spine #
- Most common cervical spine fracture in patients > 65 years old
- In Old patients: minor trauma
- In Young: Significant trauma (MVA, falls from a height, skiing)
- Flexion is the most common mechanism, with anterior displacement of C1
- Pathologic fractures can also occur

Anderson and D'Alonzo classification

Table 70.10 Anderson and D'Alonzo classification of odontoid fractures

Type	Characteristics	Stability
I	through tip (above transverse ligament), rare	unstable[a]
II	through base of neck. The most common dens fracture	usually *unstable*
IIA	similar to type II, but with large bone chips at fracture site,[72] comprise ≈ 3% of type II odontoid fractures. Diagnosed by plain radiographs and/or CT	usually *unstable*
III	through body of C2 (usually involves marrow space). May involve superior articular surface	usually stable

[a]controversial, see text



Higher non-union rate in type II odontoid

- A watershed blood supply
- Small surface area of the neck of the odontoid
- Paucity of cancellous bone
- Ligaments attached to the odontoid tend to displace it

Radiographic evaluation

- X-ray: Open mouth odontoid view
- CT:

A type III odontoid fracture may be misinterpreted as type II on sagittal CT

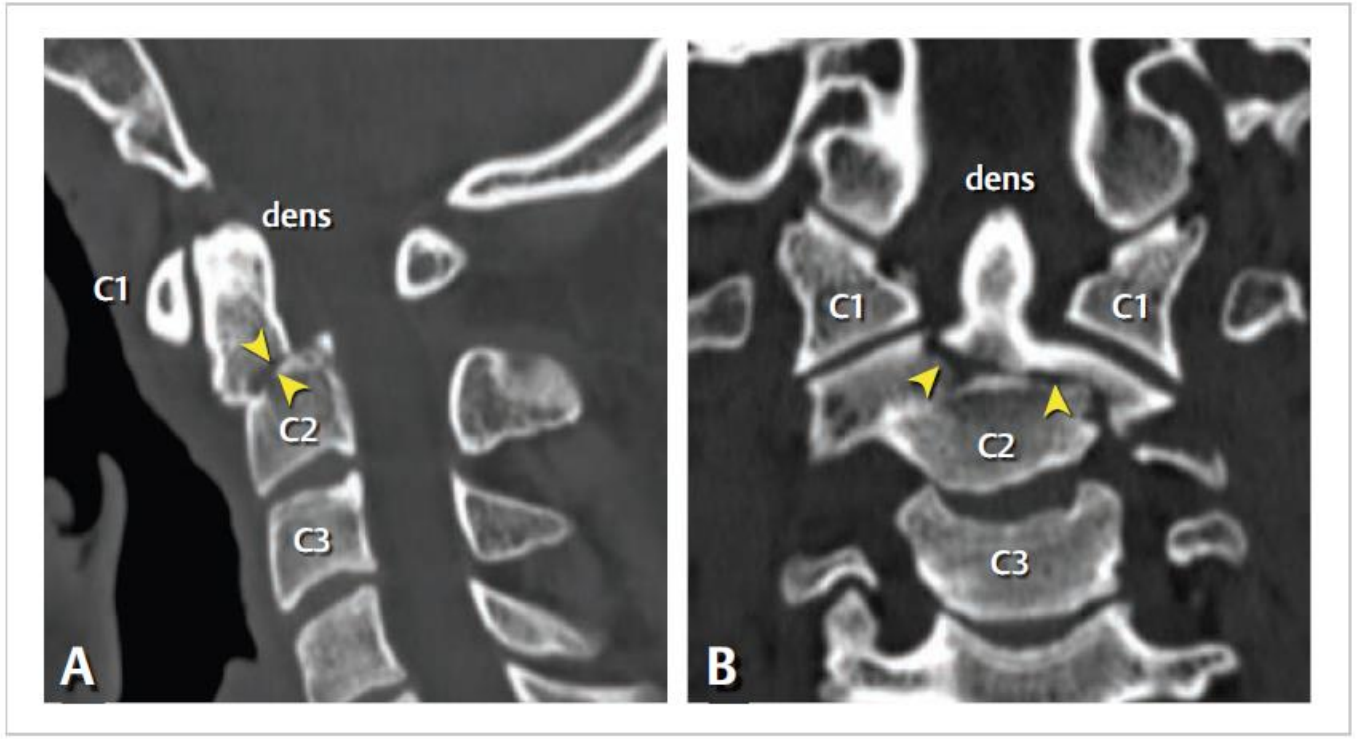


Fig. 70.5 Odontoid type III fracture (*yellow arrowheads*) with anterior displacement.
Image: CT bone windows, A: midline sagittal, B: coronal.

Signs and Symptoms

- Death: 25–40%
- Type II
  - 82% intact
  - 8% minor deficit
  - 10% significant deficit
- Type III: mostly intact
- Cervico-occipital pain, tenderness & ↓ ROM
- Tendency to support the head with the hands
- Myelopathy may develop in patients with nonunion

Treatment

Practice guideline: Management of isolated odontoid fractures

- Level II[38]: isolated Type II odontoid fractures in adults ≥ 50 years of age should be considered for surgical stabilization & fusion
- Level III[38]
  - Nondisplaced type I, II & III fractures may be managed initially with external cervical immobilization, recognizing that type II odontoid fractures have a higher rate of nonunion
  - Type II & III: consider surgical fixation for:
    a) dens displacement ≥ 5 mm
    b) or Type IIA fracture (comminution of fracture)
    c) or inability to maintain or achieve alignment with external immobilization
  - For surgical intervention, either an anterior or posterior approach may be used

Immobilization

Table 70.11 Immobilization for odontoid fractures

Fracture type	Option
Type I	collar, halo
Type II[a]	halo, collar[b]
Type IIA[a]	halo[a]
Type III[a]	collar[b], halo

[a]consider surgery for these, use indicated brace when surgery not deemed appropriate
[b]a CTO (cervicothoracic orthosis) provides better immobilization against flexion and rotation than a collar or an SOMI

- Fusion rates: Halo vest: 72%, Collar 53%
- If a halo is used, obtain supine and upright lateral C-spine X-rays in the halo. If there is movement at the fracture site, then surgery

Treatment

Type I	Type II	Type IIA	Type III
• Rare • Analysis is difficult • If there is associated atlanto-axial instability, surgery might be considered	Surgery is recommended in patients ≥ 7 years of age with any of the following: • Displacement ≥ 5mm • Instability in the halo • Age ≥ 50 years • Nonunion • TAL disrupted	• Early surgery	• ≈ 90% heal with external immobilization in 12 weeks (Halo: best)

Nonunion

Rate ≈ 30%

- Symptoms
  - High posterior cervical pain (most common)
  - Late myelopathy

Table 70.12 Radiographic criteria of nonunion of odontoid fractures

- defect in the dens with contiguous sclerosis of both fragments (vascular pseudarthrosis)
- defect in the dens with contiguous resorption of both fragments (rarefying osteitis or atrophic pseudarthrosis)
- defect in the dens with definite loss of cortical continuity
- movement of dens fragment demonstrated on flexion-extension X-rays

Treatment Options

- Anterior odontoid screw fixation
- Atlantoaxial fusion (C1–2 arthrodesis)
  - Wiring/fusion
  - Halifax clamps
  - Transarticular screws
  - C1 lateral Mass & C2 (pedicle/lateral mass/laminar) screws
- Combining anterior (transoral) decompression with posterior fusion

Anterior odontoid screw fixation

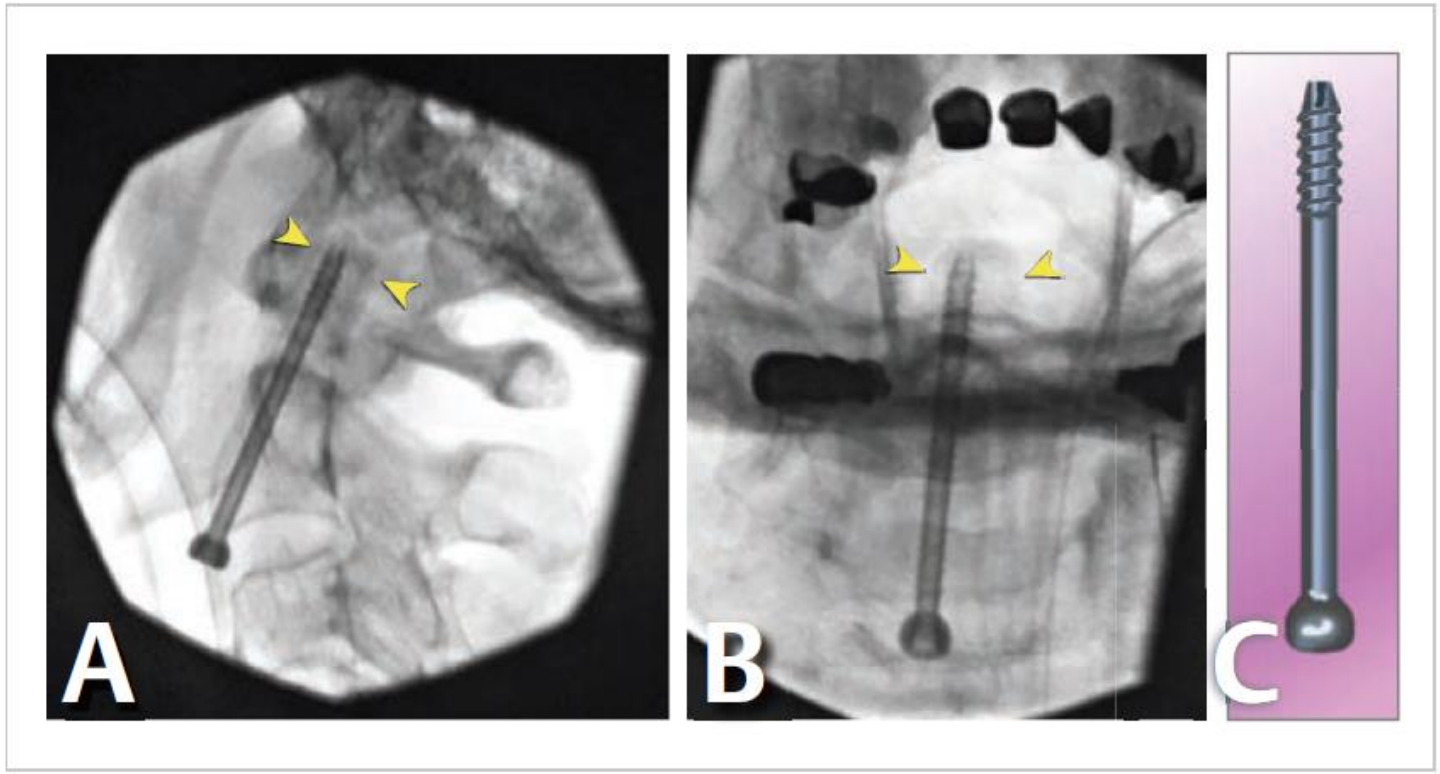


Fig. 108.1 Anterior odontoid screw.
Final radiographs, A: lateral, B: AP. The edges of the odontoid tip fragment are indicated by *yellow arrowheads*. C: illustration of a lag screw as used in this case.

Anterior odontoid screw fixation

Indications

- A reducible odontoid Type II #
- Type III # if:
  - The # line is in the cephalad portion of the body of C2, in an elderly patient who may not fuse as well with immobilization

❑ Absolute requirement: intact transverse ligament

Contraindications

- Disrupted TAL
- Irreducible #
- Large gap
- Old # (fusion if < 6m, 90%)
- Short necks/ barrel chest
- Pathological #
- # line from anteroinferior to posterosuperior

Anterior odontoid screw fixation

- Consent & prepare for posterior C1–2 fusion (if aborted)
- Video laryngoscopy, or asleep fiberoptic bronchoscopy
- Two C-arm (abort if odontoid is not adequately imaged)
- Check the trajectory with a guidewire before the incision!
- Horizontal skin incision at ≈ C5–6
- Radiolucent Caspar retractor (or tube)
- Pilot hole at anterior inferior angle of C2 in the midline
- Guidewire placement, drilling, tapping & screw placement (↓Xray)

Anterior odontoid screw fixation

- Screws: (4mm Ø, cannulated, 40–50mm length)
  - A cannulated fully threaded screw if there is a minimal gap
  - A cannulated lag screw if there is a gap
  - If no lag screw, overdrill the path through the body
  - If placing a 2d screw, it will be fully threaded

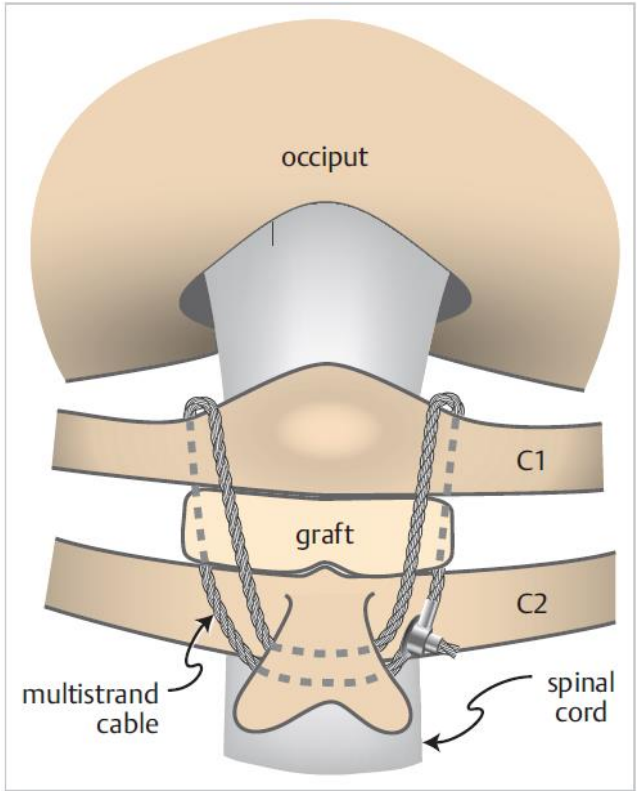
- At the end, confirm integrity of the transverse ligament (lat. D Xray)
- Keep cervical brace for 6 weeks postop
- Technical complication rate is ≈ 6%

Atlantoaxial fusion (C1–2 arthrodesis)

Wiring/fusion

- Now infrequently used as the primary fixation
- Usually used in conjunction with the transarticular screws
- Cannot be used if the posterior ring of C1 or C2 is not intact
- Graft: from the posterior iliac crest, ≈ 4cm length and ≈ 1cm height

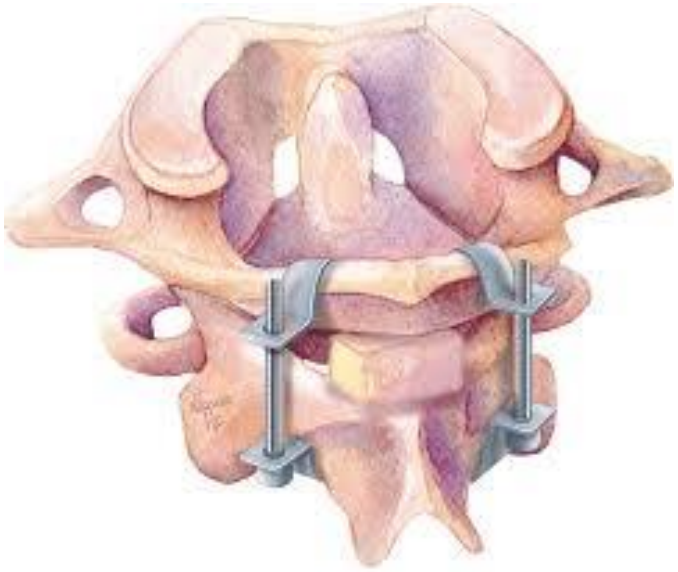
Dickman and Sonntag



Atlantoaxial fusion (C1–2 arthrodesis)

Halifax clamps

- Effective in minimizing movement in flexion
- Less stable in extension or with rotation
- Also requires intact posterior elements

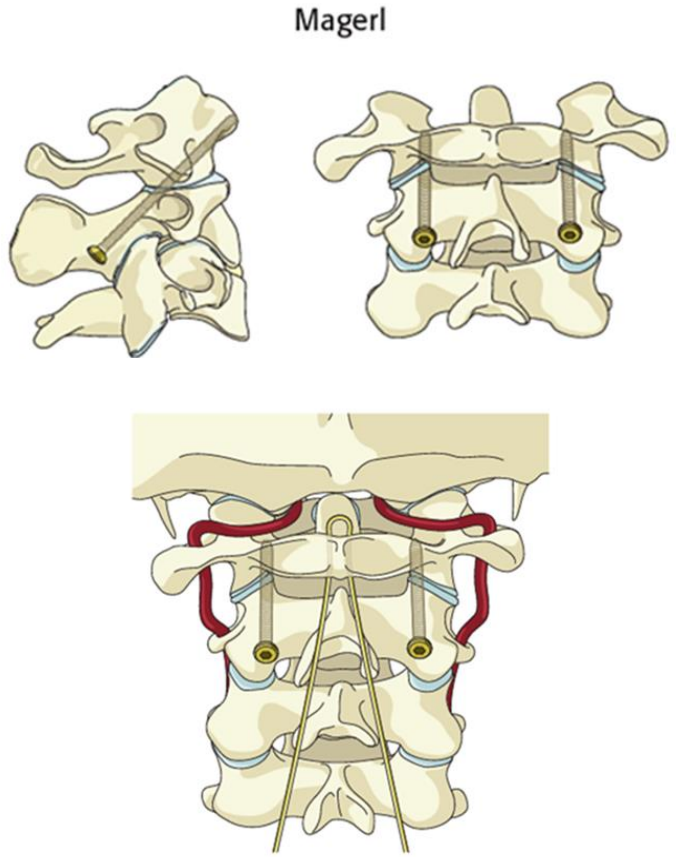




Atlantoaxial fusion (C1–2 arthrodesis)

Transarticular screws

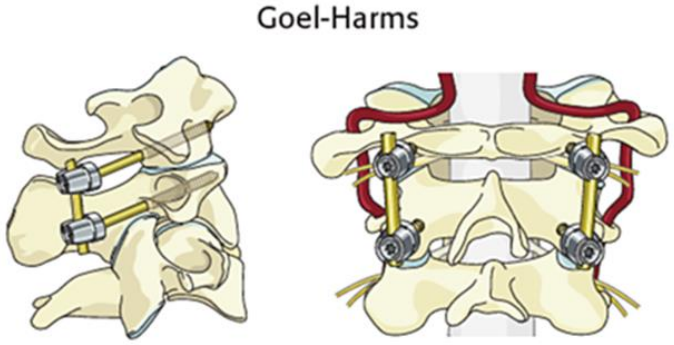
- Risk: injury to a high riding vertebral artery
- If VA injury is suspected during the placement of 1st screw, don't insert the other side screw
- Entry site for the drill guide through a separate stab wound, around the T1–2 level, 2–3cm off the midline
- Controls mainly rotation
- Requires posterior wiring



Atlantoaxial fusion (C1–2 arthrodesis)

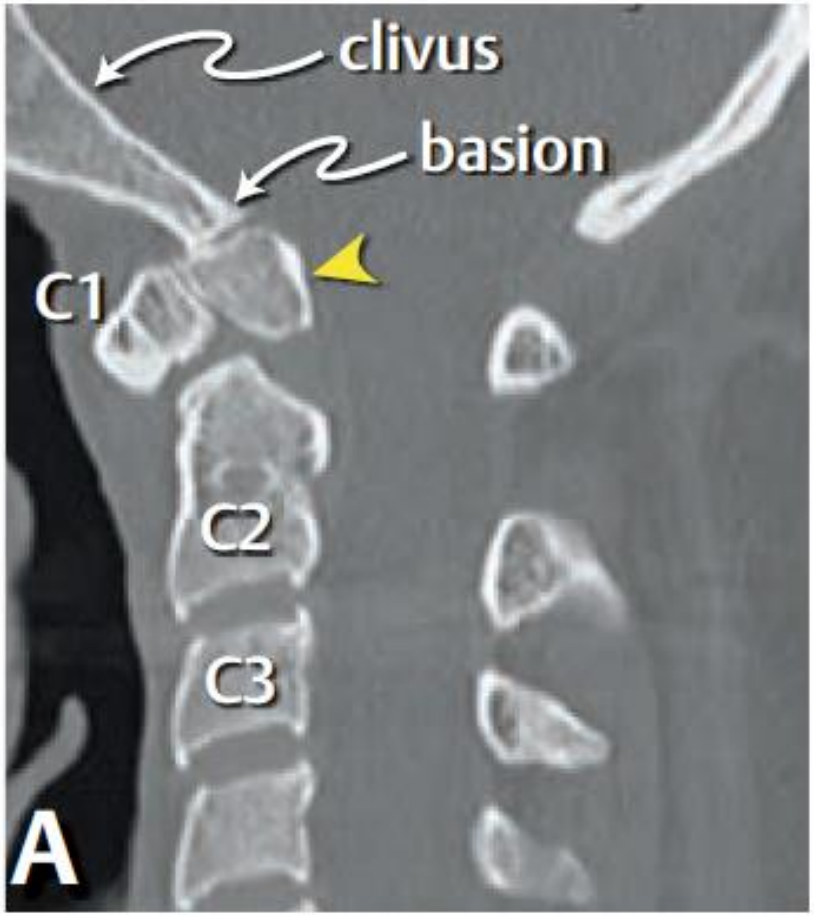
C1 lateral Mass & C2 pedicle screws

- Respects the joint line
- Highly adaptable; can bypass arterial variations
- Multi-directional rigid fixation
- No pre-reduction needed
- Standalone construct; does not require supplemental wiring
- Universal posterior cervical exposure (no separate incision)



Os odontoideum

- A separate bone ossicle of variable size with smooth cortical borders separated from a foreshortened odontoid peg, occasionally may fuse with the clivus
- ? Congenital ? Acquired
- Natural history is variable



Os odontoideum

Practice guideline: Management of os odontoideum

Level III[94]

- patients without neurologic signs or symptoms:
  - may be followed with clinical & radiographic surveillance
  - or posterior C1–2 fusion may be done
- patients with neurologic signs or symptoms or C1–2 instability: posterior C1–2 internal fixation and fusion
- if surgery is done: if rigid internal instrumentation is not used, then post-op halo immobilization is recommended (e.g., following posterior wiring & fusion)
- for patients with irreducible cervicomedullary compression and/or evidence of associated occipitoatlantal instability: occipital-cervical fusion ± C1 laminectomy
- for patients with irreducible cervicomedullary compression, consider ventral decompression

Thanks



Any Questions?