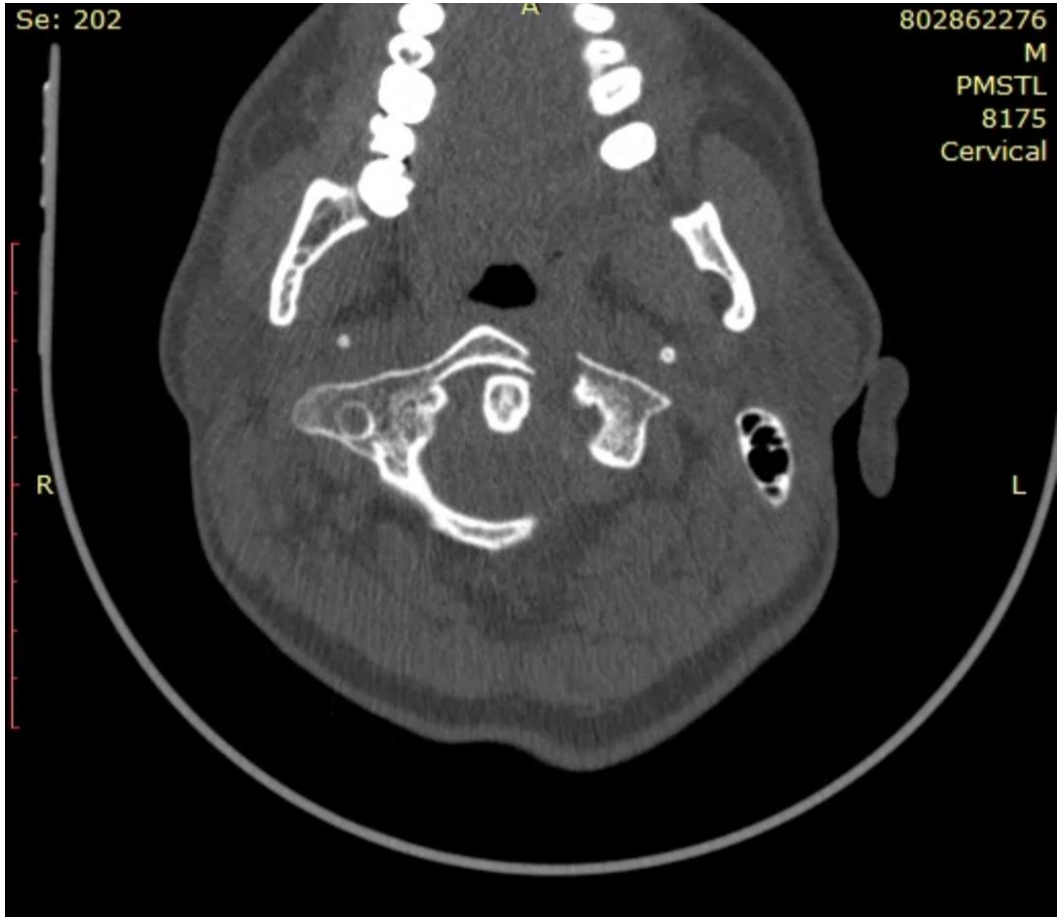
Case

- 35 years old male
- Presented with neck pain since 1 week after diving headfirst into shallow water
- Neurologically intact

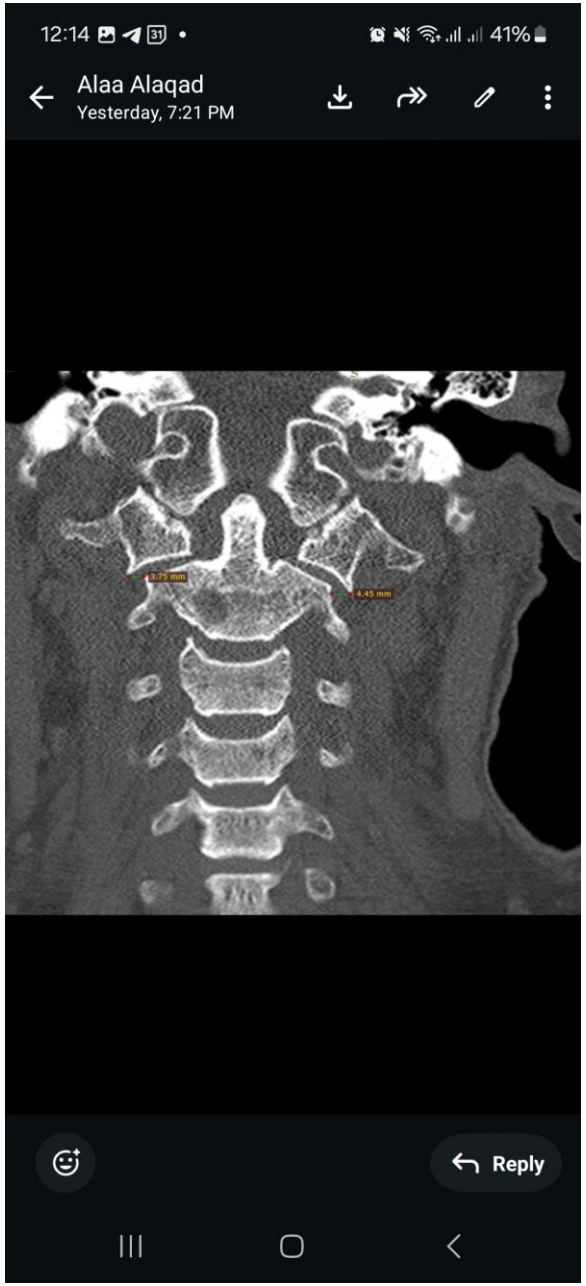
➢ Next step?

CT


Se: 202
A
802862276
M
PMSTL
8175
Cervical
R
L


Se: 202
A
802862276
M
PMSTL
8175
Cervical
R
L

CT



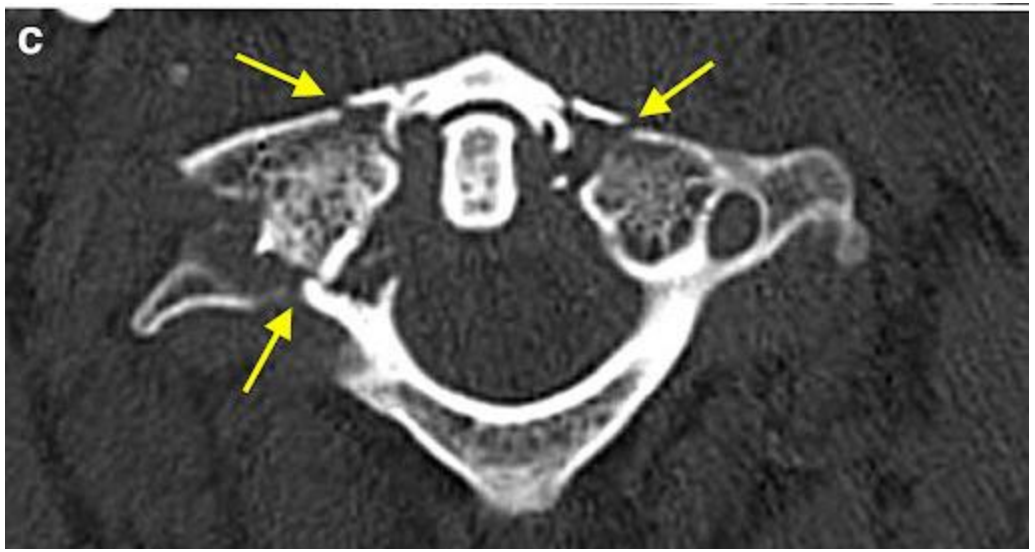
Jefferson Fracture

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

Definition

- A four-point (burst) fracture of the C1 (Atlas) ring
  - Mechanism: Axial loading
- Now includes 3 or 2-point fractures (more common)





Epidemiology

- ❑ 3–13% of cervical spine fractures.
- ❑ 56% of patients had isolated C1 fractures
- ❑ 44% had combination C1–2 fractures
- ❑ 9% had additional non-contiguous C-spine fractures
- ❑ 21% had associated head injuries

Clinical presentation

- ❑ Neck pain (most common)
- ❑ Rare Neurodeficit (Wide canal, Fragments forced outward)
- ❑ Swallowing difficulties (due to prevertebral swelling)
- ❑ Greater occipital neuralgia (from C2 root injury)
- ❑ Posterior circulation ischemia (from Vertebral artery dissection)
- ❑ Lower cranial nerve (IX-XII) palsies

Imaging

- ❑ Thin cut high-resolution CT (C1-C3)

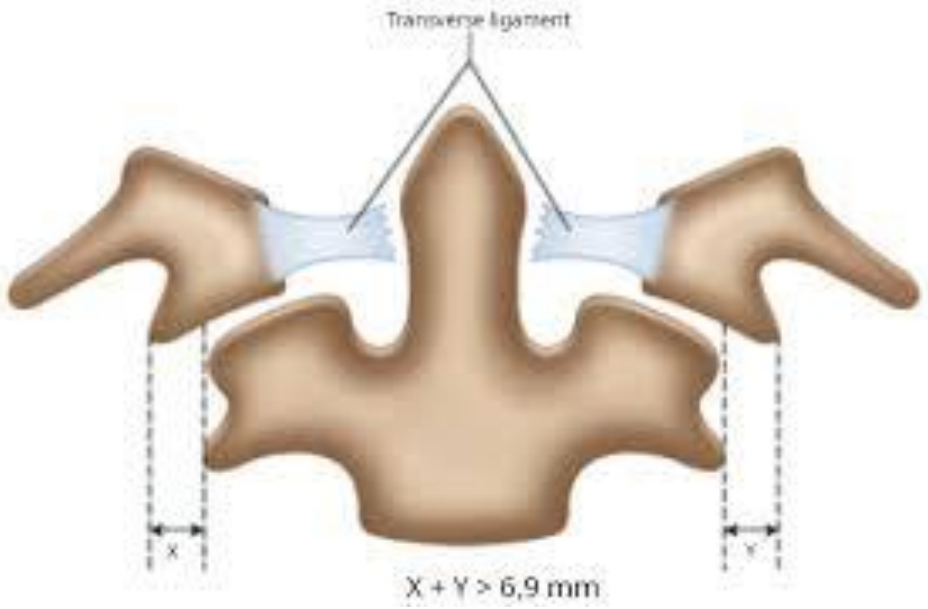
- ❑ MRI (to assess TAL “transverse atlantal ligament” injury)
  - Integrity of the transverse (atlantal) ligament (TAL) is the most important determinant of stability in C1 fractures

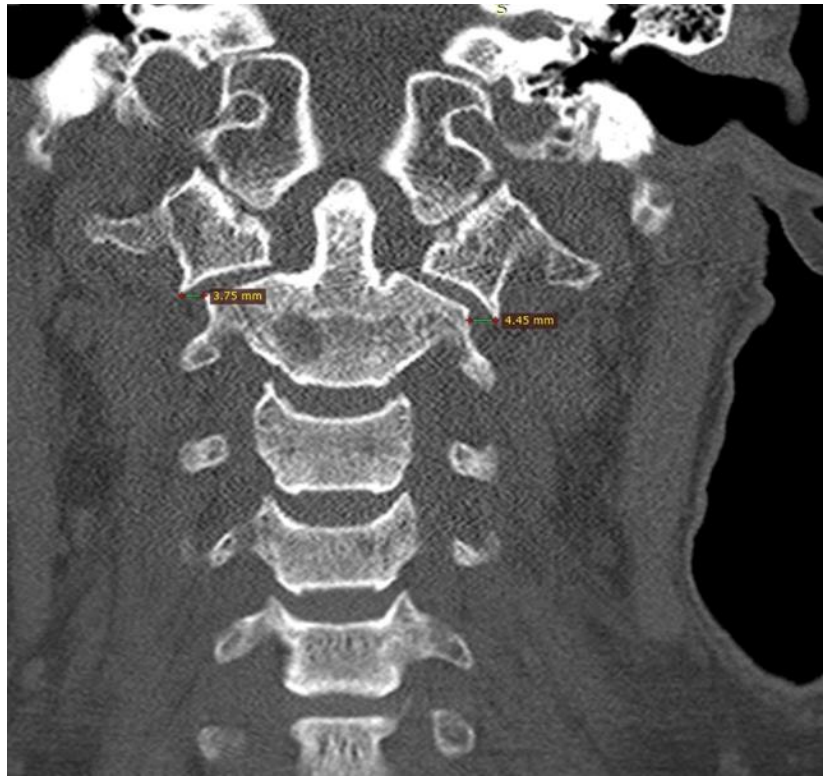


Criteria for TAL disruption

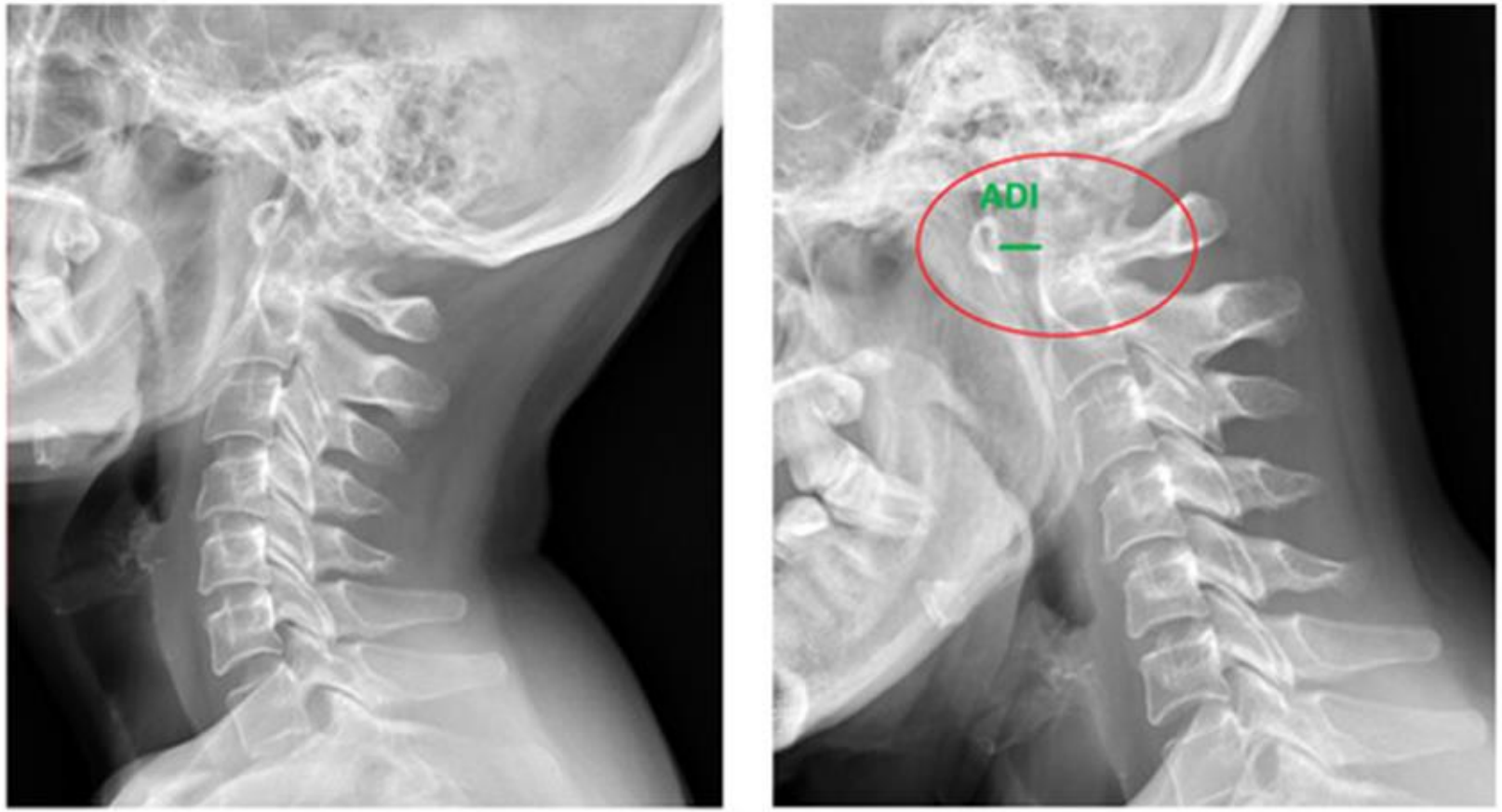
- ❑ LMD (overhang) ≥ 7mm (rule of Spence)
- ❑ Atlantodental interval (ADI) > 5mm in adults
- ❑ Evidence of disruption or avulsion of the TAL on MRI

LMD (lateral mass displacement) ≥ 7mm (Rule of Spence)





ADI (Atlantodental interval)



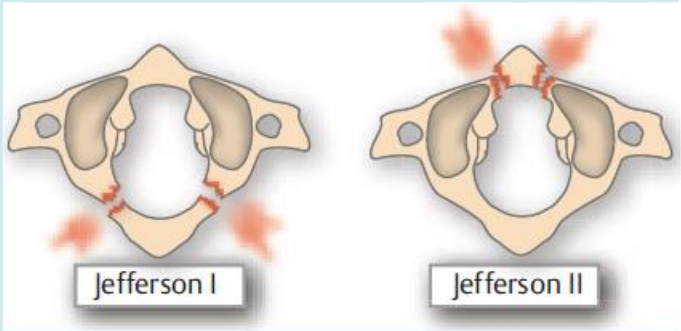
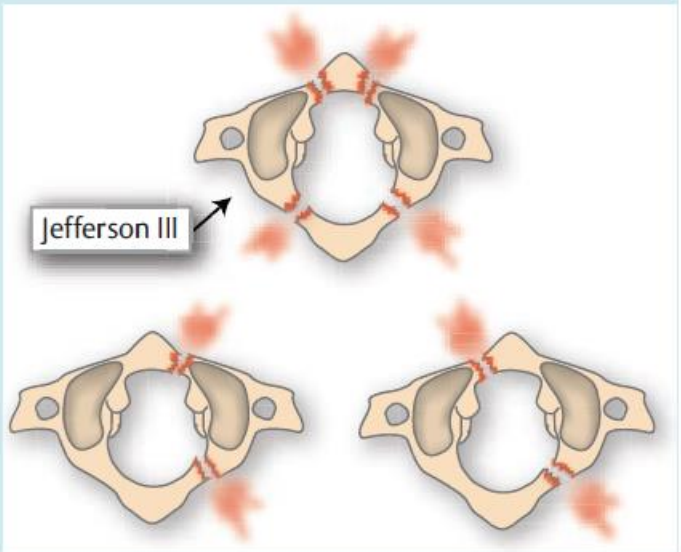
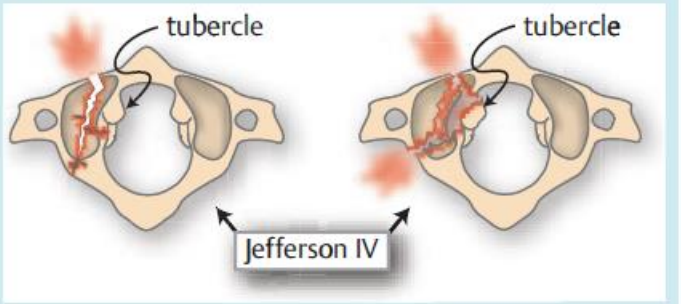
Types of TAL injury

- Dickman Type I: Tear of TAL itself without osseous component
  - Rare
  - Unlikely to heal
  - Requires surgical stabilization

- Dickman Type II: Detachment of the C1 tubercle from the C1 lateral mass
  - 74% chance of healing with immobilization (halo recommended)

Classification & Management

Table 70.7 Classification and management of isolated C1 (atlas) fractures

Landells class[46]	Illustration & Jefferson Classification[41]	Treatment recommendations[a 38]
Type I posterior arch alone or anterior arch alone (single arch) 31–45% of C1 fractures		rigid immobilization[b] X 8–12 weeks[c]
Type II anterior AND posterior arch ("burst fracture") 37–51%		**TAL intact**[d] (i.e., stable) • rigid immobilization[b] X 10–12 weeks[c] **TAL disrupted**[d] (i.e., unstable) • halo[e] X 12 weeks • or surgical stabilization & fusion
Type III lateral mass fractures (comminuted) 13–37%		rigid immobilization[b] X 8–12 weeks[c]

Practice guideline: Treatment of isolated atlas fractures

Practice guideline: Treatment of isolated atlas fractures

Level III[42]

- treatment is based on the fracture type and integrity of the transverse atlantal ligament (TAL)
- if the TAL is intact[a]: cervical immobilization alone[b, c] (for Landells types I & III, nondisplaced fractures have been effectively treated with external immobilization)
- if the TAL is disrupted[a]: either
  a) cervical immobilization alone[b, c, d]
  b) or surgical fixation and fusion

Barrow Neurologic Institute (BNI) management guidelines for isolated C1 fractures

Treatment	Indication	Notes
Surgical fusion	Dickman Type I TAL disruption (pure ligamentous injury)	
Immobilization for 3 months after which flexion/extension C-spine X-rays are obtained, and surgical fusion is performed if unstable	TAL intact on MRI and LMD< 7mm	Cervical collar X 3 months
	Dickman Type II TAL disruption (bony avulsion)	Halo X 3 months
	LMD≥ 7mm	

Rigid cervical immobilization
Which device to use?

Rigid collar	SOMI (sternal-occipital-mandibular immobilizer)	Halo-vest
		

Rigid cervical immobilization
Which device to use?

- There is insufficient evidence to recommend any of the mentioned cervical immobilization devices over the other

- Although evidence is lacking, some prefer halo-vest when there is TAL disruption (unstable fractures)

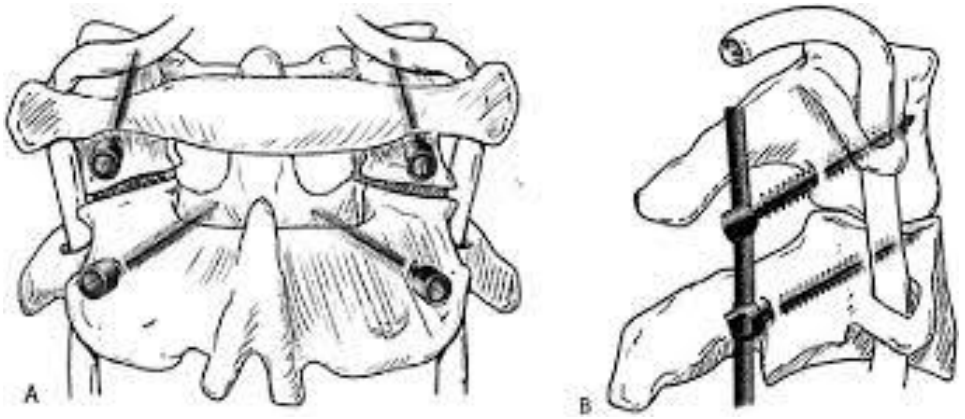
Surgical Options

- ❑ C1–2 fusion (≈ 50% of head rotation will be lost)
  - C1–2 fusion using polyaxial screws connected by rods
    - C1: screws placed in lateral masses.
    - C2 screw options:
      - screws may be placed in pedicles
      - screws may be placed in lateral masses
      - crossed C2 laminar screws
  - C1–2 posterior transarticular facet screws (TAS) → risk of vert. art. injury

- ❑ Occipitocervical fusion (reserved for complex, highly unstable #)
  - ➢ 30%-50% of neck flexion will be lost

Surgical Options

Lateral Mass C1 and Pedicle C2 Screws (Goel-Harms)

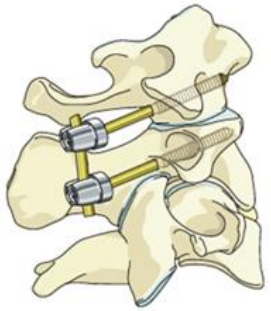


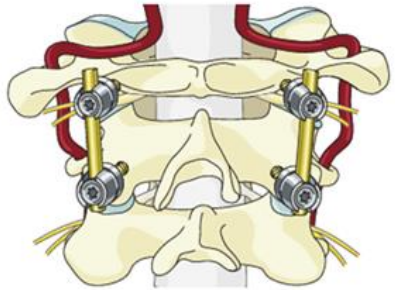
C1–2 posterior transarticular facet screws (TAS) (Magerl)



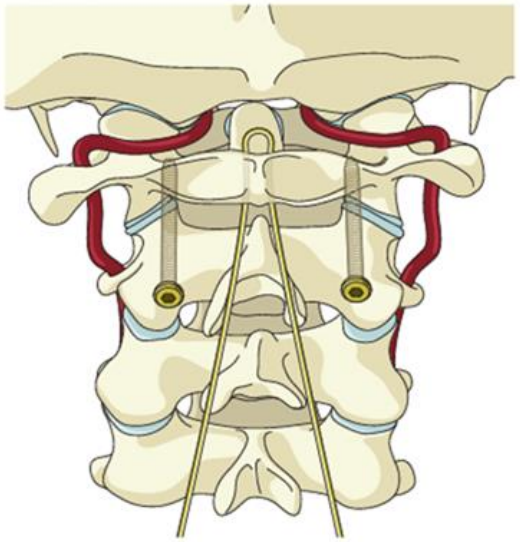
Surgical Options

Lateral Mass C1 and Pedicle C2 Screws (Goel-Harms)





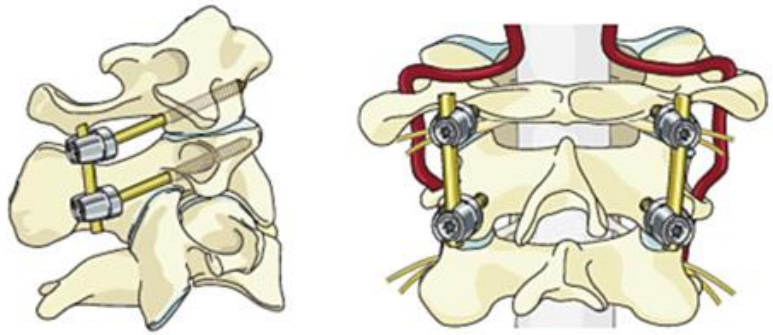
C1–2 posterior transarticular facet screws (TAS) (Magerl)



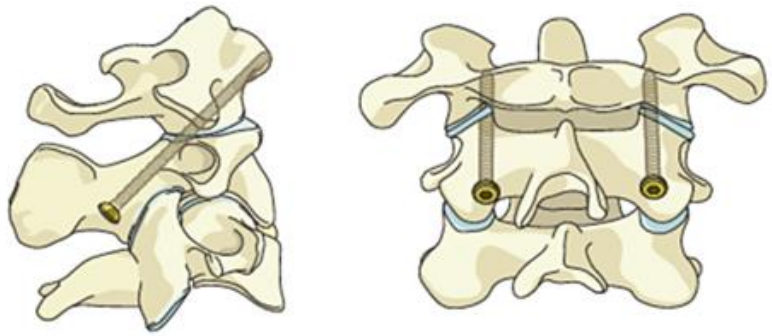
Surgical Options

C1-C2 fusion

Goel-Harms



Magerl

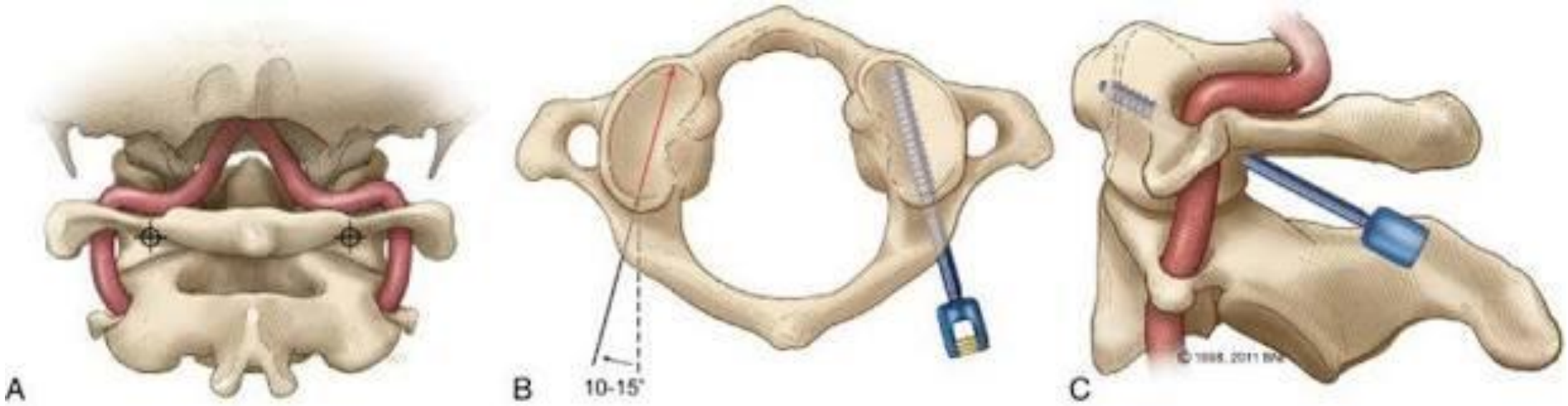


Surgical Options
C1-C2 fusion

Goel-Harms 1994	Magerl 1987
Standalone construct; does not require supplemental wiring	Requires posterior wiring
Multi-directional rigid fixation	Controls mainly rotation
Universal posterior cervical exposure (no separate incision)	Require a separate stab wound, around the T1–2 level, 2–3cm off the midline
No preoperative reduction needed	Requires preoperative reduction
Respects the joint line	Violate the joint
Highly adaptable; can bypass arterial variations	Not adaptable with risk to a high riding vertebral artery. If VA injury is suspected during the placement of 1st screw, don't insert the other side screw

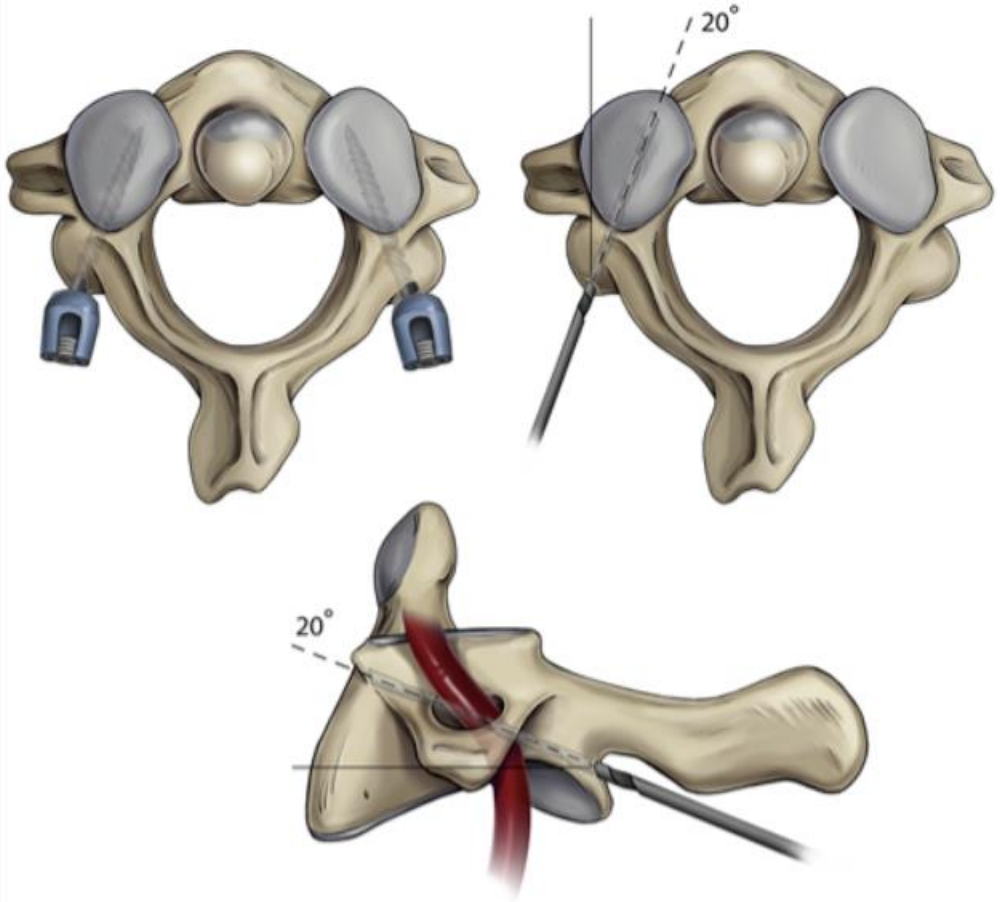
Surgical Options

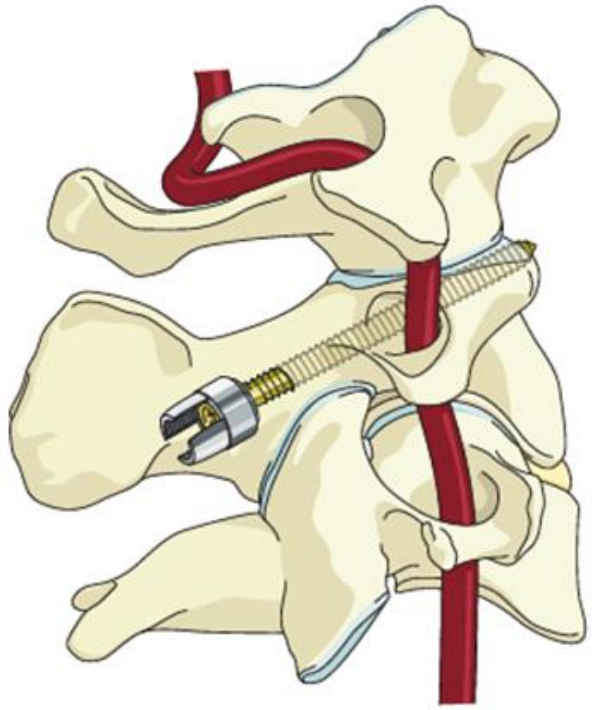
Placing C1 lateral mass screws



Surgical Options

Placing C2 pedicle screws





Surgical Options

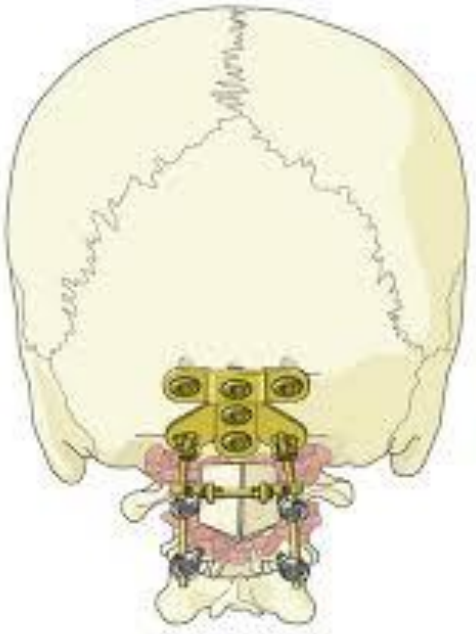
Placing C2 laminar screws

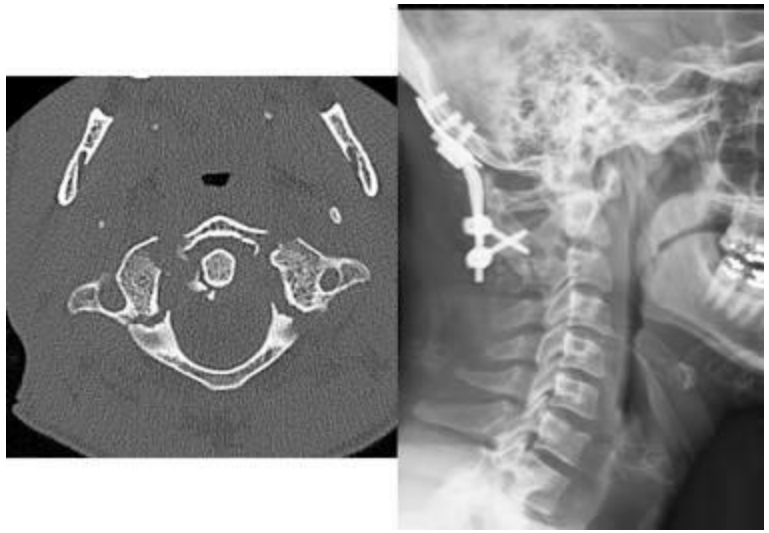


Surgical Options

Occipital-cervical fusion (C0-C2 or C0-C2-C3)







Which surgical option to choose?

C1–2 fusion

- Intact lateral masses
- Competent occipitoatlantal joint (C0-C1)
- Sufficient reduction

Occipitocervical fusion

- Comminuted lateral masses
- Concomitant occipitoatlantal joint (C0-C1) instability
- Severe irreducible displacement

Treatment for combined C1 & C2 injuries

- Base the treatment primarily on the type of C2 injury

Outcome

- Treatment without surgery when the TAL is not disrupted results in satisfactory radiographic outcome.

- Even with a satisfactory X-ray result, 20–40% of patients have neck pain after rigid immobilization

- Late complications may include basilar invagination as a result of telescoping of the odontoid through the splayed ring of C1 into the foramen magnum.

Thanks



Any Questions?