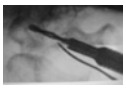



Motor Skills Lab
Cervical Arthrodesis

Mesfin A. Lemma, MD
Johns Hopkins Spine

Goals and Objectives

Goals and Objectives
Lab Set Up

- 4 Stations
  - 4-5 residents per station
- Start posterior, then proceed anterior
- All stations have supplies to perform:
  - Lateral mass screw fixation
  - C1-2 fixation
  - ACDF

Goals and Objectives
Posterior Cervical Spine

- Be familiar with local bony, vascular and neural anatomy
- C1-C2 instrumentation
- Sub-axial instrumentation
- Upper thoracic instrumentation

Goals and Objectives
Anterior Cervical Spine

- Be familiar with correlation of surface landmarks and corresponding cervical level
- Smith-Robinson approach
- ACDF +/- Corpectomy

Goals and Objectives

- Note: There will be a video demonstration following the power point slides.
- Additional reading should not be necessary if you complete this module.

Posterior Cervical

Posterior Cervical
Exposure

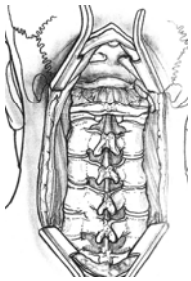
- Identify levels by surface digital palpation
- Once exposed, identify the following structures
  - Cervical levels
  - Lateral mass margins
  - Vertebral artery at the level of the C1 arch
  - C1 lateral mass
  - C2 nerve root and C2 pedicle

Posterior Cervical
Instrumentation

- Spinal instrumentation – Sub axial spine
  - Lateral mass fixation C3-C6
  - Pedicle screw placement C7
  - Upper thoracic pedicle screw placement (optional)
- Spinal instrumentation – C1-2
  - C1 lateral mass screw fixation
  - C2 pedicle screw fixation
  - C1-2 transarticular screw fixation (optional)

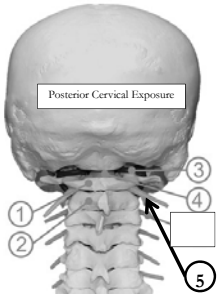
Posterior Cervical
Exposure

- Expose posterior elements
- C2, C7 most prominent
- C3-6 are bifid
- Dissect out VA at C1 arch
- Identify venous complex over C1-2 facet
- Identify C2 root



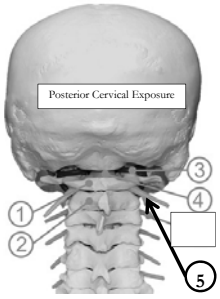
Posterior Cervical
Exposure

- 1. Posterior ring of C1
- 2. Lamina of C2
- 3. Vertebral artery
- 4. Spinal cord
- 5. C2 nerve root



Posterior Cervical
Vertebral Artery

- Arises from subclavian artery
- Enters foramen transversarium at C6
- Turns laterally at C2
- Exits foramina transversarium at C1
- Travels posteriorly at C1 (vertebral groove)
- Ascends superiourly along clivus

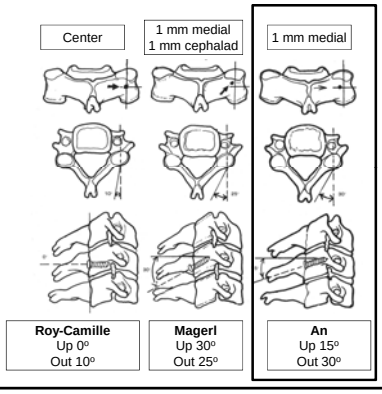


Lateral Mass Screw Fixation

Lateral Mass Screw Fixation

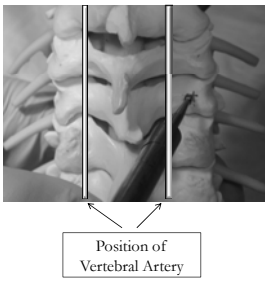
- Identify borders of the lateral mass
- Starting point 1 mm medial to midpoint
- Aim 30º lateral and 15º rostral

Lateral Mass Screw Fixation



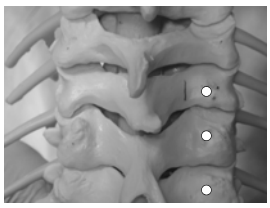
Lateral Mass Screw Fixation

- Understand position of exiting nerve roots (ventral to SAP)
- Understand where VA lies (ventral, in line with lamina/lateral mass junction)



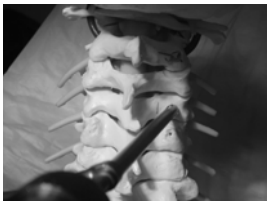
Lateral Mass Screw Fixation
Step 1

- At C3, mark starting point with bone awl
- Keep other starting points in alignment, C4-6



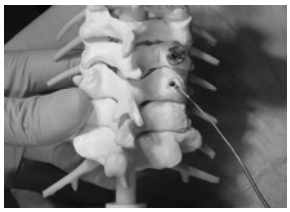
Lateral Mass Screw Fixation
Step 2

- Use 2.5 mm drill bit to place screws
- Set at 12 mm depth
- Increase in 2 mm increments until bicortical purchase achieved (optional)



Lateral Mass Screw Fixation Step 3

- Screw insertion
  - Palpate tract with malleable ball-tip
  - Tap
  - Verify screw loaded correctly
  - Place screw



Lateral Mass Screw Fixation Step 4

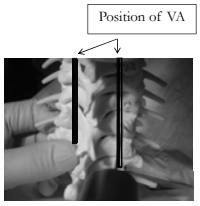
- Place your rod
- Secure with set screws
- Torque wrench

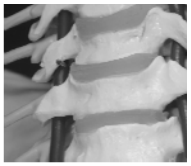
Lateral Mass Screw Fixation Pitfalls

- Poor purchase/trajectory
  - → Bailout screw (0.5mm larger)

Lateral Mass Screw Fixation Pitfalls

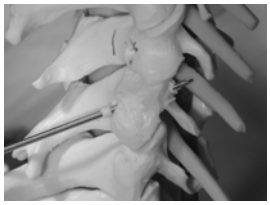
- Aim too medial
  - →VA at risk
  - Ascends ventral, in line with lamina/lateral mass junction





Lateral Mass Screw Fixation Pitfalls

- Aim too high, too deep
  - → Nerve at risk
  - Passes anterolaterally, deep to caudal superior facet



Lateral Mass Screw Fixation Video Presentation

Lateral Mass Screw Fixation Case Example



67 y.o. man with progressve myelopathy

S/p C3-6 lami and fusion

C1-C2 Arthrodesis

Current Fixation Options

- Posterior ring
  - Wire
  - Clamp/Hook
- C1-2 transarticular screws
- C1 lateral mass screw + C2 pedicle screw fixation (Harms, Spine 2001)

This is what we will be concentrating on in the lab.


C1-2 Instability


C1 lateral mass - C2 pedicle screw

Technique
C2 Pedicle Screw Placement

- Expose posterior elements
- Identify VA along top of C1 and venous complex over C1-2 facet
- Mobilize C2 root
  - Cranial for C2 pedicle screw
  - Caudal for C1 lateral mass screw

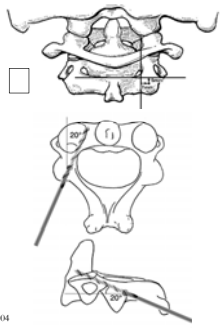
Technique
C2 Pedicle Screw Placement

- Expose upper surface of C2 pedicle (top figure)
- Detach atlantoaxial member with a small currette
- Palpate medial edge of C2 pedicle (bottom figure)

Note: Canal volume at C1-2: 1/3 dens, 1/3 spinal cord, 1/3 empty


Technique
C2 Pedicle Screw Placement

- Mark entry point with bone awl
- Trajectory
  - Palpate medial edge of pedicle
  - Aim along pedicle axis
  - Usually 20º up and in



Laude, Maitrise Orthop, 2004

Technique
C2 Pedicle Screw Placement

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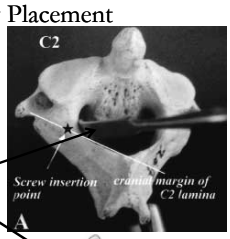
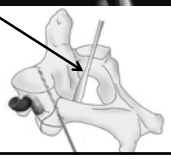




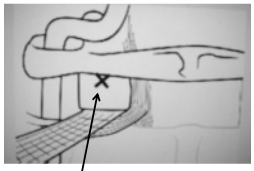
Laude, Maitrise Orthop, 2004

Technique
C1 Lateral Mass Screw Placement

- Expose C1 ring
- Expose lateral mass below C1 ring
- Mobilize C2 nerve root caudally (shown)

Technique
C1 Lateral Mass Screw Placement

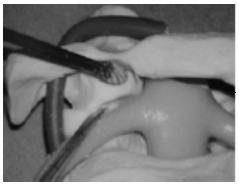
- Palpate the medial wall of the lateral mass
- Identify starting point 3-5 mm lateral to medial wall (shown)



Starting point for C1 lateral mass screw

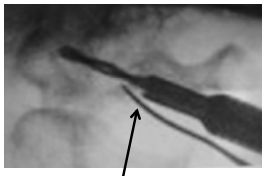
Technique
C1 Lateral Mass Screw Placement

- Consider drilling away overhang of posterior ring for better visualization (may use kerrison punch for this during the lab).



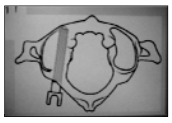
Technique
C1 Lateral Mass Screw Placement

- Protect the C2 nerve caudally
- Aim 15º medial and 20º cranially



Penfield protecting C2 root

Technique
C1 Lateral Mass Screw Placement

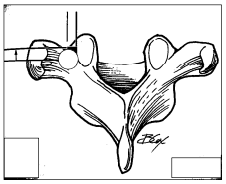


Final position

Alexander, 2007

Technique (optional)
Upper Thoracic Pedicle Screw Placement

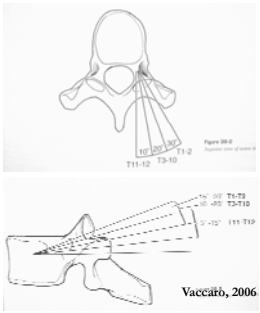
- Expose posterior elements
- Starting point:
  - Mid-TP
  - Pars



Vaccaro, 2006

Technique (optional)
Upper Thoracic Pedicle Screw Placement

- 30º mediallization
- 15º-20º caudal angulation

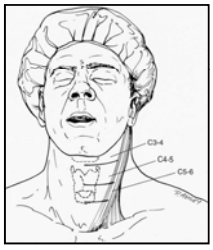


Vaccaro, 2006

Anterior Cervical

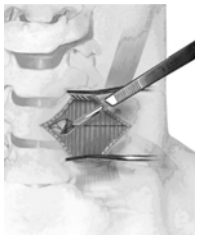
Technique
Anterior Cervical Approach

- External landmarks
  - C1 arch - Hard palate
  - C2-3 - Lower border of mandible
  - C3 - Hyoid
  - C4-5 - Thyroid cartilage
  - C6 - Cricoid



Technique
Anterior Cervical Approach

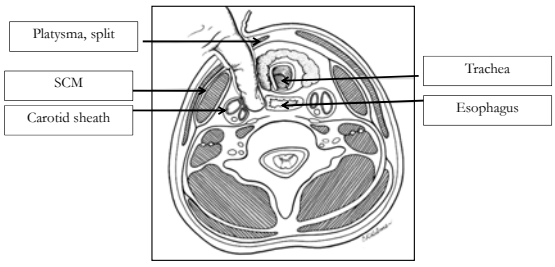
Incision



Platysma is split

Sehati, 2008

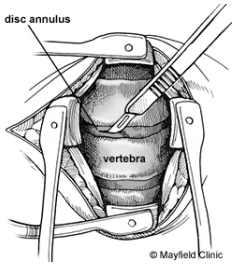
Technique
Anterior Cervical Approach



Tip: Palpate midline, then slide your finger laterally. The first "valley" identifies your dissection plane.

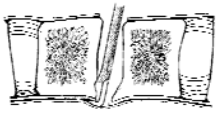
Technique
Anterior Cervical Approach

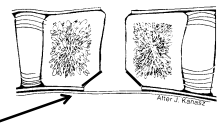
- Incise and remove disc



Technique
Anterior Cervical Approach

- Incise and remove disc
- Split PLL
- Use kerrison punch to remove posterior osteophytes as shown



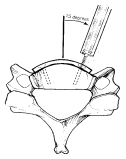


"Erlenmeyer flask " technique

Vaccaro, 2006

Technique
Anterior Cervical Approach

- Apply cervical plate
- Screws should be angled 15º medially (as shown) to improve pull-out strength



Technique
Anterior Cervical Approach

- As a final step, dissect out vertebral artery as it ascends through <u>foramen transversarium</u>

Have fun !