Craniocervical Stabilization

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Summary

✓ Craniocervical instability - definition
✓ Stabilization techniques
  - Odontoid Screw Fixation
  - C1-C2 Wire Fixation
  - C1-C2 Transarticular Screw Fixation
  - C1-C2 Segmental Screw Fixation
  - Occipito Cervical Fixation

Cranio-cervical instability

Etiology

1- Trauma
   - Odontoid fracture
   - Ligamentous injuries
   - Combined C1-C2 fracture
2- Rheumatoid arthritis
3- Congenital abnormalities
4- Tumors
5- Iatrogenic
Cranio-cervical instability

Symptoms

- Pain
- Deformity - Torticollis
- Neurological symptoms

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Odontoid Screw Fixation

Indications

- First described in 1975 by Bohler
- A physiological procedure since it maintains rotation
- No need to take a bone graft
- No Halo fixation
- Anderson and D’Alonzo type II fr with
  - Greater than 4 mm displacement
  - Greater than 10 degrees of angulation
  - Age greater than 40
  - Posterior displacement (anterior displacement may also be screwed)
  - First 8 weeks after trauma
  - Multilevel trauma
  - Nonunion
**Odontoid Screw Fixation**

**Contraindications**
1. Obliquity – anterior caudal to posterior cranial w/o buttress plate
2. Transvers ligament rupture
3. Nonreduced fractures
4. Anterior dislocations?

**Surgical Technique**
- Supine position
- Awake nasotracheal intubation with slight neck extension
- Mayfield head holder
- Position AP/Lateral fluoroscopy with monitors placed opposite the operating surgeon
- Two plane fluoroscopy and extensive setup

Ensure that anatomic reduction and an unobstructed drill approach angle has been achieved; image the K-wire superimposed over the screw trajectory.

Reduction may be achieved by pushing the distal or proximal fractured segment.

Some surgeons do not perform in anterior dislocations.
Odontoid Screw Fixation

Surgical Technique

Two screw technique

Alternatives

Anterior C1-C2 transarticular screwing

May be used after anterior odontoid resection

Technically demanding

Alternatives

C1-C2 plate

Craniocervical instability definition

Stabilization techniques

C1-C2 Transarticular Screw Fixation

C1-C2 Segmental Screw Fixation

Occipito Cervical Fixation

Summary

C1-C2 Transarticular Screw Fixation

C1-C2 Segmental Screw Fixation

Occipito Cervical Fixation
Site preparation and wire passing

C1-C2 Wire Fixation
Gallie fusion

Need however a postop halo brace....

Became popular and then abandoned because of high failure rate....

C1-C2 Halifax Clamp Fixation

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C1-C2 transarticular screw fixation

**Indications**
- Indicated for atlanto-axial instability. A good alternative to occipitocervical fixation
- Biomechanically stronger than wiring
- Obtain & maintain reduction
- C2 arch not necessary
- Technically demanding

Normal atlanto-axial anatomy confirmed in CT scan

Ligamentous (non-traumatic) instability of the atlanto-axial segment due to:
- Rheumatoid arthritis
- Infection
- Degeneration
- Trauma
  - Rupture of the transverse ligament
  - Fractures of the atlas and axis

C1-C2 instability due to loss of bone (tumor, infection)
Os odontoideum
After transoral dens resection ??

**Contraindications**
- Congenital malformations (ill-defined anatomy)
- Very high vertebral artery groove
- Missing pedicles of the axis, bony abnormality on the entrance of screw
- Severe osteoporosis
- Upper thoracic kyphosis

**Preoperative cautions:**
- Variations of the vertebral artery
- Severe cervical lordosis
- Cervico-thoracic kyphosis
- Unreducible pathology
C1-C2 transarticular screw fixation

Complications

- Injury to the vertebral artery (inappropriate in 20% of cases)
  (if one artery is injured, the other side should not be drilled and fusion with conventional techniques should be applied)
- Injury to the spinal cord
- Hardware failure

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C1-C2 Segmental Fixation
Harms 2001
* First introduced by Goel
* An alternative to posterior transarticular screw fixation
* Lower risk of injury to the vertebral artery

Grup A Basilary invagination
Posterior Reduction
Goel

- 65 y.o female, 5-6 months R arm and leg weakness, gait disturbance, sphincter problem. Quadriparetic, basilary invagination and C1-2 dislocation.
Functional X rays: slight increase of dislocation during flexion. C1 assimilation.
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Indications

- Extensive occipito-cervical bony destruction (Craniectomy in foramen magnum, upper cervical laminectomy)
- Absence of C1 arch due to a congenital malformation or after decompression
- Congenital abnormalities of the occipito-cervical articulation
- Basilary invagination
- Nonreduced subluxations of C1-C2
- Complex fractures of C1 and C2
- Unstable complex Jefferson fractures

Contraindications

- Osteoporosis
- Destruction -iatrogenic- of occipital bone

Disadvantages

- Reduced head and neck movements due to restriction of Oc-C1-C2 articulations
  - Flexion-extension: 30%
  - Lateral rotation: 10 degrees
  - Lateral deviation: 8 degrees
- High nonunion rates

Occipito Cervical Fixation

Surgical Preparation and Position

- Prone position, neck is neutral
- Lateral C arm control
- Mayfield head holder
- Reduction with traction
- Preop CT: Thickness of occipital bone, VA anomalies
- Bone graft should be placed between occiput and cervical vertebrae
Occipito Cervical Fixation

Fixation techniques

- Wires with Loops/plates
  - Hartshill rectangle
  - Threaded Steinmann pin
  - Titanium rod
  - Titanium frame
  - Ransford loop
- Screws and plates
  - CD rod/screw plate
- Screws and rods

Wire-Rod/Plate combination

- Luque-Hartshill rectangle
- Hartshill-Ransford loop

Wires with loops/plates & bone cement

Case with plate and wires

C2 osteoblastoma - Ventro-lateral retropharyngeal approach

Occipito cervical fixation using two axis plates and titanium wires

October 1997 - June 1998
18 y.o. Female, basilar invagination and Chiari type I, tetraparesis, 9th and 10th nerve palsy, tonsillar herniation, PB-C2 9 mm

Transoral odontoid resection, Foramen magnum decompression, Duraplasty, Occipitocervical fusion

Case with plate and hooks

Occipito Cervical Fixation
Plate-Screw systems

Two plates
Less rigid

Y plate
More rigid

Distances between two loops are 30 or 35 mm
Three different lengths of cervical plates with 3-4 and 5 holes
Plates have 120 degrees of angulation to fit the occipito-cervical inclination
3-4 occipital screws (6-8 mm cortical screws)
C2 isthmus screw
C2-C5 lateral mass screws
Cervical screw directions

C2 screw may be directed to pedicle or isthmus

C3-C6 lateral mass screws

C2 screw may be directed to pedicle or isthmus (25 degree medial and rostral)

A wire may be added to C1 arch.

51 y.o., male, Tetraparesis, Chiari type I (tonsillar herniation), Basilar invagination, PB C2 12 mm

Case with plate and screws

Transoral odontoid resection
Foramen magnum decompression
Duraplasty
Occipitocervical Fixation
Y plate
Midline occiput has a thicker bone.
Screw purchase is more stable.

Case with Y plate and screws
There are long and short plates.
A midline screw may hold the graft.

Case with Y plate and Screws
Assimilation of atlas to occiput.

Rod-Screw systems
More rigid fixation.

Transoral dens resection,
occipitocervical fixation with Y plate
Complications

- CSF fistula
- Cerebellar haematoma
- Hardware related complications
  - Screw loosening
  - Pseudoarthrosis
  - Instrument breakage

Conclusion

- Occipito-cervical fixation can be achieved using many different methods.
- It causes great restriction in cervical movements
  - Flexion-extension 30%
  - Lateral rotation 10 degree
  - Lateral bending 8 degree
- Nonunion rate is high
Thank you

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