Discovery of the Spine Specialist: Instrumentation of the Cervical Spine

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Posterior Wiring Techniques

- 1891-B.E. Hadra described the first spinal fusion using instrumentation
  - wired the spinous processes in the cervical spine in an effort to halt progressive spinal deformity secondary to trauma

Posterior Atlantoaxial Arthrodesis

- 1910-Mixter and Osgood performed first posterior atlantoaxial arthrodesis using silk thread

Halifax Interlaminar Clamp

- 1975-Tucker described the use of the interlaminar clamp and screw system

Posterior Atlantoaxial Arthrodesis: Interspinous Wiring Techniques

- 1940s

Posterior Atlantoaxial Arthrodesis: Interspinous Wiring Techniques

- 1978-Brooks and Jenkins described their method of posterior C1-C2 wiring
**Posterior Atlantoaxial Arthrodesis: Interspinous Wiring Techniques**

- 1989-C1-C2 interspinous wiring method was introduced

**Posterior Atlantoaxial Arthrodesis: Transarticular Screw Fixation**

- 1987-Magerl and Seemann

**Posterior Atlantoaxial Arthrodesis: Transarticular Screw Fixation**

**Posterior Atlantoaxial Arthrodesis: C1 lateral mass-C2 pedicle/pars Screw Fixation**
Pre-op CT Sagittal Reconstruction

C1 Lateral Mass Screw Placement with Image Guidance

C2 Pedicle Screw Placement with Image Guidance

C1 Lateral Mass / C2 Pedicle Screw-Rod Fixation

C1 Lateral Mass / C2 Pedicle Post-op Screw Placement
Posterior Atlantoaxial Arthrodesis: C1-C3 lateral mass screw/rod construct

Preoperative imaging studies-RO

Intraop Landmarks

Final Construct

Postop Imaging

Anterior Odontoid Screw Fixation

- Late 1970s-Nakanishi et al, Magerl, Bohler
- Advantages:
  - immediate fixation
  - high fusion rates
  - preserved atlantoaxial rotation
- one vs. two screws
Anterior Odontoid Screw Fixation

Occipitocervical Fusion
• 1927-Foerster
• 1937-Cone and Turner

Advantages:
- rigid internal fixation
- simplicity
- contoured rod

Disadvantages
- intact posterior elements

The threaded Steinman pin is easily contoured using the BendMeister

The BendMeister allows for smooth contours
Occipitocervical Fusion

- Plate and screw constructs
  - 1966: Cregan
  - 1986: Roy-Camille et al.
  - 1991: Grob et al.

Occipitocervical Fusion

- In recent years: multitude of OC plate and screw systems developed
  - Purchase midline or lateral occiput
  - Connect to a variety of lateral mass systems used in the subaxial cervical spine

Decompression with Occipital Cervical Fixation with Screw Rods

- 1970s: Lateral mass systems started to be used in Europe:
  - Louis system
  - Roy-Camille system
  - Magerl AO/ASIF system

Lateral Mass Constructs
Lateral Mass Constructs

- Roy-Camille system
  - 3mm contoured chrome-cobalt plates
  - Screws could be angled and inserted perpendicular to plate, angled laterally 10 degrees
  - Advantages/disadvantages

- Magerl AO/ASIF system
  - Thin 1mm hook plate with 1-2 holes
  - Screws widely angled and inserted with trajectory parallel to facet joint and 20-30 degrees lateral
  - Advantages/disadvantages

Lateral mass constructs were being used in Europe for nearly two decades before making their appearance in the United States.

- In 1988, Cooper et al. reported on their use of the Roy-Camille system in 20 pts with cervical instability secondary to trauma
  - Achieved fusion in 19/20 pts
  - Minimal complications
  - Concluded that lateral mass plating was excellent method for cervical stabilization and was superior to wiring

- Haid Universal Bone Plate (UBP) system
  - Introduced in 1989
  - Composed of titanium
  - 2, 3, or 4 hole plates
  - Contoured
Lateral Mass Constructs
- Haid Universal Bone Plate (UBP) system

Lateral Mass Fusion
Anterior Cervical Instrumentation

- Anterior Cervical Fusion (ACF)
  * Bailey and Badgley-1950s
  * Cloward, Smith, Robinson refined the technique
  * high incidence of pseudoarthrosis (40%) and kyphotic deformity in multilevel procedures

The History of Anterior Cervical Instrumentation

- Bohler, 1964
- Orozco and Llovet-Tapies, 1970

Classification System for Anterior Cervical Constructs

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Classification System for Anterior Cervical Constructs

- **Semi-Constrained**: Locked bone screws which allow construct motion
- **Rotational**: Locked bone screws with rotation at plate/screw interface
- **Translational**: Locked bone screws with translation and/or rotation at plate/screw interface

Codman, Blackstone, Peak, Aline, Acufix, Deltaloc, Zephir, Atlantis (hybrid and variable)

The Ideal Plate

- Low profile
- Fixed and variable screws
- Rescue screw
- Two screw fixation per level
- Locking mechanism
- Titanium

Orozco AO/ASIF Plate

-Introduced in 1972
- “H” shaped plate
-Stainless steel
-Unrestricted backout
-Bicortical

Caspar Plate (Aesculap)

-Introduced in 1982
-No locking mechanism
-Unrestricted backout
-Variable screw trajectory
-Bicortical screw purchase
Synthes Plate

- Introduced in 1986
- Developed by Morscher
- Unicortical screws
- Titanium
- Locking mechanism
- Restricted, constrained device
- 12, 14, 16mm length screws
- 4.0 and 4.35 diameter

Orion Plate (Sofamor Danek)

- Introduced in 1993
- Unicortical
- Fixed trajectory
- Locking mechanism
- Restricted, constrained device
- Central diagonal slot

Codman Plate (Slim Lock) (Johnson and Johnson)

- Introduced in 1996
- Variable screw trajectory
- Cam locking mechanism
- Semicomstrained, rotational device
- 2.7mm plate thickness
- One diameter screw-4.5mm
Slim Lock (Johnson and Johnson)

- Introduced in March, 1998
- The first translational cervical system
- Visualization of graft

DOC Plate (Acromed)

- Semiconstrained rotational AND translational devices

ABC (Aesculap) Premier (Sofamor Danek)

- Semiconstrained rotational AND translational devices

Atlantis plate (Sofamor Danek)

- Introduced June, 1998
- Multiconstruct system
  - constrained
  - semiconstrained, rotational
- Floating washer design as lock mechanism

Atlantis plate (Sofamor Danek)

- Fixed Angle
- Variable Angle
The Evolution of Anterior Cervical Instrumentation

The Future of Cervical Instrumentation: BMP

The Future of Cervical Instrumentation: Artificial disc

The Future of Cervical Instrumentation: Resorbable Implants
Timeline of Cervical Instrumentation

THANK YOU