C1 C2 FUSION INDICATION
TECHNIQUE AND COMPLICATION

MODERATOR DR S S KALE
C1 C2 WIRE FIXATION

- FIRST DESCRIBED BY HADRA IN 1891
- MODIFIED BY CONE IN 1937
- THREE BASIC CABLE WIRE FIXATION
  - GALLIE
  - BROOKS
  - SONNTAG -DICKMAN

CAGAR YS, PAIT TG, ORZEN S. THE AXIS: POSTERIOR STABILIZATION OPTIONS. CONTEMPORARY NEUROSURGERY
C1 C2 WIRE FIXATION

• INDICATED IN AAD WHEN POSTERIOR ELEMENT OF C1 C2 ARE INTACT

• CONTRAINDICATION
  – ABSENT POSTERIOR ELEMENT
  – SEVERE OSTEOPOROSIS
  – NARROW CANAL DIAMETER
GALLIE

- 20 GAUGE WIRE UNDER C1 ARCH
- INFERIOR PART NOTCHED OVER SPINOUS PROCCESS OF C2
- H SHAPED GRAFT PLACED IN BETWEEN DECORTICATED C1 AND C2 ARCH
- NOTCH INFERIORLY IN THE MIDLINE
- OFFER LITTLE ROTATIONAL OR EXTENSION STABILITY
- HIGH RATE OF NON UNION

BROOKS

- SUPERIOR TO GALLIE IN BIOMECHANICAL STUDIES ESPECIALLY ROTATION
- CARRIES RISK OF PASSING ADDITIONAL WIRE BENEATH TWO LAMINA
- TWO RECTANGULAR BONE GRAFT FASHIONED TO WEDGE BETWEEN C1 AND C2

SONNTAG DICKMAN

• ONE BICORTICAL GRAFT WEDGED BETWEEN C1 AND C2
• SINGLE SUBLAMINAR WIRE PASSED UNDER C1
• WIRE LOOPED BELOW C2 SPINOUS PROCES TRAPPING THE GRAFT BETWEEN C1 C2
• AVOIDES PASSING SECOND SUBLAMINAR WIRE

C1 C2 WIRE FIXATION

• FUSION RATES INCREASE WHEN EXTERNAL ORTHOSIS IS USED

• NEUROLOGICAL COMPLICATION INCLUDING QUADRIPARESIS CAN OCCUR IN UPTO 5 TO 7 % OF CASES

• BREAKAGE OF WIRE MIGHT OCCUR

GEREMIA GK, KIM KS, CERULLO L, CALENOFF L. COMPLICATION OF SUBLAMINAR WIRING. SURG NEUROL 1985;23; 625-229
GROB D, GASCO JJ, PANJABI MM, WARG P, DVORAK J. BIOCHAMICAL EVALUATION OF FOUR DIFFERENT ATLANTOAXIAL FIXATION TECHNIQUES. SPINE 1992; 17;480-490
INTRALAMINAR CLAMPS (HALIFAX)

- OFFERS POSTERIOR LAMINAR FIXATION WITHOUT PASSING SUBLAMINAR WIRE
- UPPER CLAMP PLACED ABOVE LAMINA OF C1
- INFERIOR CLAMP PLACED BELOW C2
- SEQUENTIAL TIGHTENING OF CLAMPS TO ENSURE ENGAGEMENT OF LAMINAE
INTRALAMINAR CLAMPS (HALIFAX)

- INTERLAMINAR GRAFT MAY BE USED
- ASSOCIATED WITH IMPLANT SLIPPAGE
- HIGH PSEUDOARTHROSIS RATE
- C1 RING FRACTURE


MOSKOVICH R, CROCKARD HA: ATLANTOOAXIAL ARTHRODESIS USING INTERLAMINAR CLAMPS: AN IMPROVED TECHNIQUE. SPINE 17; 261-267,1992
TRANSARTICULAR SCREW FIXATION

• USED WHEN POSTERIOR ARCHES INCOMPETENT
• SUPERIOR TO WIRING METHODS IN FUSION RATES
• SEVERE OSTEOPENIC PATIENTS MAY REQUIRE FIXATION THROUGH ARTICULAR FACETS
• IMPERATIVE TO DELINEATE VERTEBRAL ARTERY’S COURSE
• NOT FEASEBLE IF VERTEBRAL ARTERIES ARE TOO MEDIAL
• PROVIDES ABSOLUTELY NO MOVEMENT IN THE REGION
• PROCEDURE IS TECHNICALLY DIFFICULT
• SPINAL CORD INJURY, HYPOGLOSSAL INJURY
TRANSARTICULAR SCREW FIXATION

• MAGERL TECHNIQUE PROVIDES STIFFEST STABILIZATION WITH LEAST AMOUNT OF ROTATION AND LATERAL BENDING

• PROVIDES THREE POINT FIXATION

• FOLLOWS MOST CLOSELY BIOMECHANICAL RULES OF INTERNAL FIXATION

• FUSION RATES BETWEEN 85% TO 98% AND WELL TOLERATED IN ELDERLY

POSTERIOR TRANSARTICULARSCREW

- MAGERL AND SEEMANN (1979)
- TRANSARTICULAR SCREW PLACED THROUGH PARS INTERARTICULARIS OF C2 PENETRATING C1 C2 FACET INTO LATERAL MASSES OF C1
- SCREW DIRECTED 25 TOWARDS MIDLINE AND 25 CRANIAL
- THREE POINT FIXATION CAN BE OBTAINED
LATERAL MASS SCREW FIXATION

• JURGEN HARMS TECHNIQUE OF C1 C2 FIXATION
• C1 LATERAL MASS SCREW AND C2 PEDICLE SCREW WITH ROD RECONSTRUCTION
• REDUCTION OF C1 C2 CAN BE ACHIEVED USING ROD AS A LEVER ARM
• CAN BE USED IN PATIENTS WITH COMPROMISED POSTERIOR ELEMENT
• EASIER THAN PLACEMENT OF TRANSARTICULAR SCREWS

HARMS J,MELCHER RP, POSTERIOR C1 C2 FUSION WITH POLYAXIAL SCREW AND ROD FIXATION. SPINE 2001; 2467-2471
C1 LATERAL MASS WITH C2 PEDICLE SCREW

• ACHIEVED 100% FUSION RATE

• ANATOMIC ALIGNMENT NOT NECESSARY

• TECHNICALLY DEMANDING


C2 PARS SCREW

- C2 PARS SCREW AVOIDS TRANSARTICULAR PLACEMENT OF SCREW
- AVOIDS OPERATIVE RISK BUT COMPROMISE HOLDING STRENGTH
- USE SAME ENTRY POINT AS MAGERL
- SCREW ANGLED 10 TO 15 DEGREE MEDIANALLY AND 35 DEGREE SUPERIORLY
OCCIPITO CERVICAL STABILIZATION

• INDICATED IN PATIENT WITH AAD, OCCIPITALISED HYPOPLASTIC OR BIFID ATLAS
• POSTERIOR DECOMPRESSION OF FORAMEN MAGNUM AND C1 ARCH REQUIRED ESPECIALLY ARNOLD CHIARI
• FIXED AAD WHERE EXTENSIVE OSTEOLIGAMENTOUS EXCISION REQUIRED
OCCIPITO CERVICAL STABILIZATION

• WIRE AND BONE GRAFT FUSION BY ARTIFICIAL ARCH OF ATLAS
• BONY RIDGE OF OCCIPITAL BONE AND OCCIPITALIZED ATLAS CREATED
• ARTIFICAL ARCH AND C2 DECORTICATED AND ONE MIDLINE AND TWO LATERAL NOTCH FORMED
• WIRE PASSED THROUGH THE NOTCH
• GRAFT OF ILIAC CREST WEDGED BETWEEN C2 AND ARTIFICIAL ARCH AND WIRE IS TIGHTENED
OCCIPITO CERVICAL FUSION

ADVANTAGES

• CORRECTS AP AND ROTATIONAL MOVEMENTS OF ATLAS PROVIDING THREE DIMENSIONAL REDUCTION

• STABLE INTERNAL FIXATION WITH EXCELLENT BONE TO BONE CONTACT

• SIMPLE TECHNIQUE
OCCIPITO CERVICAL FUSION

DISADVANTAGE

• CANNOT BE USED IN PATIENT WITH LARGE DISTANCE BETWEEN OCCIPITALIZED ATLAS AND C2 C3 AND NARROW CANAL

• CANNOT BE USED IN PATIENT WHERE POSTERIOR DECOMPRESSION IS UNDERTAKEN
OCCIPITO CERVICAL FUSION

• CONTOURED RODS
• C1 ARCH REMOVED
• ROD IS PLACED OVER OCCIPITAL BONE AND C2 AND C3
• ROD FIXED OVER OCCIPITAL BONE BY THREE BURR HOLES AND WIRES PASSED THROUGH IT
• ABSOLUTE BONY CONTACT IS REQUIRED TO PREVENT VERTICAL MOVEMENTS
ANTERIOR C1 C2 FIXATION

• DESCRIBED BY GOEL
• Harms and colleagues have recently used transoral technique
  • technique is performed with the use of a “T-plate
  • horizontal portion of the plate is placed over the C1 lateral masses anteriorly and screws are placed through the plate apertures into the anterior C1 lateral mass
  • vertical portion of the plate rests on the body of C2 inferior to the base of the dens
• THANK YOU