Harms technique

see Jürgen Harms.

C1 lateral mass screw placement & C2 pedicle screw placement.

- 1. A modification of Goel technique.
- 2. Uses C1 lateral mass screws and C2 pedicle screws connected by rods.
- 3. Provides strong fixation and avoids the need for external immobilization.

Posterior C1-C2 fusion with polyaxial screw and rod fixation for atlantoaxial fusion described by Atul Goel and Laheri, and subsequently modified by Jürgen Harms.

The Harms technique of stabilizing C1-C2 by fixation with polyaxial screws and rods is a further option for atlantoaxial fusion from the dorsal approach. Harms and Melcher published this method in 2001¹⁾, but the operation had first been performed by Harms in August 1997.

C1 lateral mass screws (Harms technique) in combination with C2 instrumentation (pars, pedicle, translaminar screws) have become a mainstay of surgical treatment. The surgical anatomy of the C1 lateral mass can be challenging especially with the robust venous plexus that often causes significant bleeding with exposure of the C1-C2 articular complex 2 .

Operative Steps

Positioning

Prone position with head fixation (e.g., Mayfield clamp).

Fluoroscopy for intraoperative guidance.

Exposure

Midline posterior approach to the upper cervical spine.

Identification of C1 posterior arch and C2 pars/pedicles.

Screw Placement

- 1. C1 lateral mass screws and C2 pedicle or pars screws are inserted.
- 2. Image guidance (fluoroscopy, navigation) is often used.

4. Rod Placement & Fusion

- 1. Rods are placed to connect screws.
- 2. Bone grafting (autograft/allograft) is added to promote fusion.

5. Closure & Postoperative Care

- 1. Layered closure.
- 2. Postoperative bracing (varies by surgeon preference).
- 3. Follow-up imaging (X-ray/CT) to confirm fusion.

Approach

Completely expose the C1–C2 complex. Dissect over the superior surface of the C2 pars interarticularis to expose the C1–C2 joint to accurately locate the entry point for the C1 lateral mass screws. Bleeding is controlled with bipolar cautery and/or Gelfoam-thrombin. Complete exposure of the posterior face of the inferior C1 facet also mobilizes the C2 root from the underlying attachments and facilitates its inferior mobilization.

C1 lateral mass screws ENTRY visualization commonly requires caudal retraction of the C2 dorsal root ganglion (occasionally this may not be feasible; sacrificing the C2 root may be required but this can lead to post-op pain and numbness; technique is to divide the preganglionic nerve fibers and to close the dural defect). The screw entry point is the midpoint of the inferior part of the C1 lateral mass (for both mediolateral and cranio-caudal directions). An awl or a 1- to 2- mm high-speed drill is used to mark the position to prevent slippage while drilling the hole. Drilling a portion of the inferior arch of C1 is sometimes needed to allow screw placement (caution: the thickness of the arch in the craniocaudal dimension varies widely, and the horizontal segment of the VA lies immediately above – use pre-op CT for planning) C1 screw TRAJ averages $\approx 17^{\circ}$ medially, $\approx 22^{\circ}$ rostrally, TARGET the superior aspect of the anterior tubercle of C1 on lateral fluoro



C1 SCREWS 3.5 or 4mm diameter, length is determined from pre-op fine-cut CT to obtain bicortical purchase (CAUTION: the ICA maybe as close as 1mm to the ideal exit site of the screw some authors use only unicortical purchase). The screw needs to be proud to bring it up to the level of the C2 screw (it may actually be necessary to have the C1 screw protruding 1–2 mm more than the C2 screw in order to allow rod attachment), and it should have an \approx 8 mm unthreaded superficial portion to minimize irritation of the C2 nerve which could produce occipital neuralgia C2 pedicle (pars) screws, if a fusion is to be performed: the posterior arch of C1 and the C2 lamina are decorticated with a drill. Onlay fusion substrate is then placed, taking care not to compress the dura. Optional adjunct: intraarticular decortication and packing bone within the C1–2 joint. Cadaveric specimens were measured to determine appropriate placement for C1 lateral mass screws. Instrumentation guidelines were developed and used to instrument a series of cadaveric specimens. Clinical experience with C1 lateral mass fixation was reviewed to evaluate results. Postoperative computed tomographic (CT) scans were reviewed to evaluate screw placement.

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The cadaveric study measured the dimensions of the atlas and determined ideal trajectory for screw placement. This technique was applied clinically, and 50 cases were retrospectively reviewed for fixation difficulties, neurologic or vascular injuries, and perioperative complications. Postoperative CT scans were reviewed when available.

Halo application, posterior wiring, and C1 to C2 transarticular screws have been used to stabilize the upper cervical spine. Each technique has disadvantages, and C1 lateral mass fixation recently has gained popularity as a potential alternative. Recent anatomic studies have documented the dimensions of the C1 lateral mass and its ability to accommodate screw fixation. Small clinical series have documented early success with this technique.

Fifteen specimens were stripped of soft tissue and measured by using calipers and CT scans. Guidelines were formulated for C1 lateral mass screw fixation. Additional specimens with intact soft tissue were instrumented without difficulty. A clinical series was reviewed to evaluate for complications related to this technique. Postoperative CT scans were reviewed to evaluate screw placement.

The C1 lateral mass safely accommodated screw fixation. Trajectory of 10 degrees medial and 22 degrees cephalad was preferred. The technique was safely applied in a series of 50 patients. Postoperative CT scans showed the ability of the surgeon to achieve the intended goals for starting point and safe trajectory.

C1 lateral mass fixation is a safe alternative for upper cervical fixation with several potential advantages versus other techniques, but further clinical evaluation is warranted ³⁾.

Case series

Harms technique case series.

Case reports

A 6-year-old boy who sustained cervical spine injury on falling out of a tree. Initial cervical spine radiography and CT-scan did not find any traumatic lesion. Three-week check-up revealed an unstable C2 fracture in the synchondrosis at the base of the odontoid process, with anterior displacement (type IC on the classification of Hosalkar et al.), without neurological symptoms except for cervical pain and limitation of head rotation. MRI confirmed the absence of medullary lesion. The Harms technique was used to fix C1 and C2, using adult instrumentation without bone graft. Bone fusion was obtained at 8 months. Hardware was removed at 10 months. No complications were reported.

Posterior internal fixation for unstable C2 fractures in children can be effective and relatively safe⁴.

References

1)

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