Indications

NB: The patient will lose ≈ 50% of head rotation with C1–2 fusion.

Instability of the C1–2 joints, including:

1. **atlantoaxial dislocation** due to incompetence of the **transverse ligament of atlas** (TLA):
   a) **rheumatoid arthritis**: symptomatic patients, or asymptomatic patients with subluxation ≥8 mm
   b) local **infection**
   c) **trauma**
   d) **Down syndrome**: due to laxity of the TLA
2. incompetence of the **odontoid process**
   a) **odontoid fractures** meeting surgical criteria, including
      - Type II fractures with >6 mm displacement
      - instability at the fracture site in halo-vest traction
      - chronic nonunion of odontoid fractures
      - disruption of the transverse ligament
   b) following transoral **odontoidectomy**
   c) tumors destroying the odontoid process

**Vertebrobasilar insufficiency** with head turning (bow hunter’s sign).

Operative stabilization is clearly indicated when signs and symptoms of **spinal cord compression** occur. However, many recommend early operative fusion before evidence of appreciable neural compression occurs because 1) the **myelopathy** in these patients may be irreversible; 2) the overall prognosis is poor once symptoms of cord compression are present; and 3) the risk of **sudden death** associated with atlantoaxial subluxation is increased even in asymptomatic patients.

Papadopoulos et al. believe that **rheumatoid arthritis** patients in relatively good health without advanced multisystem disease and less than 65 years of age should be considered for operative stabilization if mobile **atlantoaxial subluxation** is greater than 6 mm. Seventeen patients with severe rheumatoid arthritis and atlantoaxial subluxation treated with a posterior arthrodesis are presented. A new method of fusion, devised by the senior author (V.K.H.S.), was utilized in all cases. Indications for operative therapy in these patients included evidence of spinal cord compression in 11 patients (65%) and mobile atlantoaxial subluxation greater than 6 mm but no signs or symptoms of cord compression in six patients (35%). Thirteen patients developed a stable osseous fusion, two patients a well-aligned fibrous union, one patient a malaligned fibrous union, and one patient died prior to
evaluation of fusion stability. The details of the operative technique and management strategies are presented. Several technical advantages of this method of fusion make this approach particularly useful in patients with rheumatoid arthritis. Because of multisystem involvement of this disease, a high rate of osseous fusion is often difficult to achieve 1).

### Technique

**Atlantoaxial fusion technique.**

### Case series

Thirty-three consecutive patients with unstable odontoid fractures underwent Goel technique and Harms technique (C1–2 arthrodesis). Surgery was performed with the aid of lateral fluoroscopic control in 16 cases (control group) that was supplemented by Doppler ultrasonography in 17 cases (Doppler group). Two patients in each group had a C1 ponticulus posticus. In the Doppler group, Doppler probing was performed during lateral subperiosteal muscle dissection, stepwise drilling, and tapping. Blood flow velocity in the V3 segment of the VA was recorded before and after posterior arthrodesis. All patients had a 12-month outpatient follow-up, and the outcome was assessed using the Smiley-Webster Pain Scale. Neither VAI nor postoperative neurological impairments were observed in the Doppler group. In the control group, VAls occurred in the 2 patients with C1 ponticulus posticus. In the Doppler group, 1 patient needed intra- and postoperative blood transfusions, and no difference in terms of Doppler signal or VA blood flow velocity was detected before and after C1-C2 posterior arthrodesis. In the control group, 3 patients needed intra- and postoperative blood transfusions. Useful in supporting fluoroscopy-assisted procedures, intraoperative Doppler may play a significant role even during surgeries in which neuronavigation is used, reducing the chance of a mismatch between the view on the neuronavigation screen and the actual course of the VA in the operative field and supplying the additional data of blood flow velocity 2).

### Case reports

Goel et al., reported of 3 relatively rare clinical cases in which the absence of posterior elements of the axis was associated with basilar invagination and multiple other craniovertebral junction musculoskeletal and neural abnormalities. Atlantoaxial stabilization resulted in remarkable clinical recovery in all 3 cases. C2-3 fixation was not done, and bone decompression was not done. On the basis of their experience, the authors conclude that atlantoaxial fixation is a satisfactory form of surgical treatment in patients having an association of basilar invagination with absent posterior elements of axis 3).

### References
