Basilar invagination diagnosis

Basilar invagination is diagnosed by various imaging modalities such as plain x rays, CT scans, and MRI.

Quantitated by measuring the basal angle, which on plain x-rays, measured the angle between lines drawn from the nasion to center of sella and then to the anterior foramen magnum, but on MRI was felt to be better represented by the angle between a line drawn along the floor of the anterior fossa to the dorsum sellae and a second line drawn along the posterior clivus. Normal mean basal angle: 130°. Platybasia: >145° (abnormally obtuse basal angle).

Measurements used in BI

1. McRae’s line:

![McRae's Line Diagram](image)

Drawn across foramen magnum (tip of clivus (basion) to opisthion). The mean position of the odontoid tip below the line is 5 mm (± 1.8 mm SD) on CT and 4.6 mm (± 2.6 mm SD) on MRI.

No part of odontoid should be above this line (the most accurate measure for BI)

2. Chamberlain’s line:

![Chamberlain's Line Diagram](image)

Less than 3 mm or half of dens should be above this line, with 6 mm being definitely pathologic. Seldom used because the opisthion is often hard to see on plain film and may also be invaginated. On CT and MRI the normal odontoid tip is 1.4 mm (± 2.4) below the line

3. McGregor’s line:
It refers to a line connecting posterior edge of the hard palate to the most caudal point of the occipital curve. If the tip of the dens lies more than 4.5 mm above this line it is indicative of basilar invagination.

4. **Wackenheims line**

Normally the tip of the dens is ventral and tangential to this line. In basilar invagination odontoid process transects this line.

5. **Fischgold’s digastric line**

joins the digastric notches. The normal distance from this line to the middle of the atlanto-occipital
joint is 10 mm (decreased in BI) 8).

6. **Fischgold’s bimastoid line**

![Diagram of Fischgold’s bimastoid line]

joins tips of mastoid processes. The odontoid tip averages 2 mm above this line (range: 3 mm below to 10 mm above) and this line should cross the atlanto-occipital joint.

**Basilar impression diagnosis in rheumatoid arthritis**

Erosion of the tip of the **odontoid**, commonly seen in **rheumatoid arthritis** (RA), obviates use of any measurement that is based on the location of the tip of the **odontoid** 9. For this reason, other measures have been developed, including the **Clark station**, 10.

**Redlund-Johnell criteria**, 11 and **Ranawat criteria** 12. Since even these methods will miss up to 6% of cases of BI in RA, 13, it is recommended that suspicious cases be investigated further (e.g. with CT and/or MRI).

**MRI**: optimal for demonstrating **brainstem** impingement, poor for showing bone.

**Cervicomedullary angle**: the angle between a line drawn through the long axis of the medulla on a sagittal MRI and a line drawn through the cervical spinal cord. The normal CMA is 135 – 170 °. A CMA < 135 ° correlates with signs of cervicomedullary compression, myelopathy or C2 radiculopathy 14.

**CT**: primarily done to assess bony anatomy (erosion, fractures...).

**CTA** should be performed when surgery is contemplated, to show detail of VA anatomy.

**Myelography** (water soluble) with CT: also good for delineating bony pathology.

**References**

3) McRae DL. The Significance of Abnormalities of the Cervical Spine. AJR. 1960; 70:23-46
5) Chamberlain WE. Basilar Impression (Platybasia); Bizarre Developmental Anomaly of Occipital Bone...


