Sub axial cervical pedicle screw fixation

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Abstract

Pedicle screw fixation in the lumbar and thoracic spine are well accepted and preferred by spine surgeons across the world. But there is a little reluctance for the same in the cervical spine. Leonte reported direct screw insertion of C2 pedicles in Hangman's fracture.

Pedicle screw fixation in the lower and middle cervical spine has been considered very risky, but pedicle screw fixation has bio mechanically proven its superior stabilising effect. A thorough knowledge of the local anatomy and the surgical techniques is a must before embarking on cervical pedicle screw fixation. Pre operative evaluation of vertebral artery is a must, because if the dominant vertebral artery is injured, serious neurological complications can occur.

The article describes in details the technique of screw placement in the cervical vertebra.

Keywords: Pedicle screw, cervical vertebra

Studies have shown lower rate of loosening at bone screw interface as well as higher strength after fatigue testing. Cervical pedicle screws allow rigid fixation and correction capabilities to restore physiological sagittal alignment of cervical spine. Additional screws can be used to correct mal alignment in the atlanto-occipital region, the sub axial region and the cervico thoracic junction.

It is quite valuable in single stage posterior procedures like revision after laminectomy, reduction of dislocations, when there are no added disc extrusions. But the risks associated with inadequate placement of screws into the pedicle cannot be completely obviated. A thorough knowledge of the local anatomy and the surgical techniques is a must before embarking on cervical pedicle screw fixation.
Cervical pedicle: Oblique projection X ray films show contralateral cervical pedicle seen as an oval projection into the vertebral body showing the outer and inner diameter of the pedicle.(Figure 1)

CT scan on bone window (with 1-1.5 mm slices) can be used to assess the pedicle size and pedicle morphometry. This will allow the surgeon to choose appropriate pedicle screw diameter, length and direction in the coronal plane. Sometimes the pedicle on one side can be smaller than the other side in the same vertebra showing the dominance of vertebral artery on the smaller side of the pedicle. If outer pedicle diameter is greater than 5 mm, pedicle fixation is possible. If pedicle size is less than 4 mm screw insertion is difficult or rather impossible. Then alternate mode of fixation should be sought.

Angle of pedicle screw insertion: The average angle from sagittal plane and longitudinal pedicle axis is 46° (30°-62°). Smallest angle is at C7 and largest at C4.

Vertebral artery: Even though ischaemic brain complication caused by unilateral obstruction of vertebral artery is low, pre operative evaluation of vertebral artery is a must. If dominant vertebral artery is injured, serious neurological complications can occur.

MR angiography provides significant information regarding the right left domination and anatomical variations of the vertebral artery. Vertebral artery can sometimes crook on to the vertebral body forming a loop and screw insertion into the ipsilateral side of pedicle may be too risky to the artery.

Screws: 3.5 - 4.5 mm screws can be used. There is no safe zone anterior to the vertebral body except at C2, where bicortical purchase can be obtained. The length of screws usually 18-24 mm for C3-C7. Rods are used for longitudinal fixation.

Screw placement: The point of entry for C3-C7 pedicle screw is slightly lateral to the centre of the articular mass and close to the inferior margin of the inferior articular process of the adjacent vertebra above. The lateral margin of the articular mass has a notch approximately at the level of the pedicle. The pedicles are located at the notch for C3-C6 and at or slightly above the notch for C7. The angle of insertion of the screw in the transverse plane varies from a minimum of 24° for C7 to a maximum of 60° for the C5 pedicle.

The entry point is burred and then a small curette can be used to reach up to the pedicle or a blunt K wire also can be used and checked with an image intensifier to confirm the direction and depth. The lateral pedicle wall is thinner and the medial wall is thicker. So the screw should be inserted using medial wall as a guide. Computer assisted pedicle screw insertion is also possible. But the study by Kim et al., did not show any advantage for computer based screw placement over fluoroscopy technique.

Complications
I. Directly by the screw
   - Vertebral artery lesion
   - Spinal cord injury
   - Root lesion
   - Perforation of oesophagus with probe, tap or screw
II. Not directly attributable to the screw
   - Radiculopathy by iatrogenic foraminal stenosis
   - Progressive degenerative changes at adjacent levels

Figure 3. X ray showing C 6-7 dislocation
Figure 4a, b. CT scan image showing C 6-7 dislocation and 3d reconstruction
Case Report

A 32-year-old male sustained injury to his neck at the work place. He was quadriplegic. He had grade 4 dislocation of C 6-7. MRI did not show any disc extrusion. Pedicle screw fixation enabled complete reduction of the dislocation without any added anterior procedure. He did not have to undergo a front-back-front surgery. The cost is much less with a single approach procedure when compared to procedures with multiple approaches.

Figure 5. MRI image showing the dislocation at C6 - 7

Figure 6. Intra operative photograph showing the ligamentous disruption

Figure 7. Post operative radiographs AP and Lateral views showing the implants in situ

References


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