Case Report

C7 intralaminar screw placement, an alternative to lateral mass or pedicle fixation for treatment of cervical spondylytic myelopathy, kyphotic deformity, and trauma: A case report and technical note

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Abstract

Background: The authors present a case to illustrate the necessity and technical feasibility of C7 laminar screw placement for treatment of sub-axial cervical spondylytic myelopathy. The indications for C7 lateral mass screw placement was required internal fixation, with small lateral masses (8 mm) and pedicles (4 mm).

Case Description: A 67-year-old female with compressive myelopathy after a fall from standing is presented. Magnetic resonance (MR) imaging of the cervical spine showed severe C3-6 spondylosis with canal and foraminal compromise. Computed tomography of the cervical spine confirmed the MR imaging findings as well as showed suboptimal lateral mass and pedicles for screw placement. The patient underwent a C3-6 laminectomy, C3-6 lateral mass, and C7 laminar screw placement. Postoperatively, the patient recovered without complication.

Conclusion: Internal fixation of the cervical spine after iatrogenic destabilization by decompression of neural elements secondary to advanced spondylosis can be technically challenging. Anatomical landmarks needed for safe placement of lateral mass or pedicle instrumentation are often distorted by the patients’ advanced pathology or inherent biology. The C7 screw is a key structural element to a long construct and therefore necessitates large lateral masses or pedicles to safely place a functional screw. C7 laminar screws may be placed safely without fluoroscopic guidance when sufficient C7 lateral mass or pedicle screws are not possible or with undue risk.

Key Words: Intralaminar fixation, myleopathy, sub-axial cervical spine, stenosis, trauma

INTRODUCTION

Internal fixation of the sub-axial cervical spine can be a challenge in patients with complex anatomy (small lateral mass or pedicle) and advanced spondylitic arthropathy. The former prevents optimal screw size to add stability to a construct while the later makes optimal screw placement a challenge secondary to distortion of normal anatomical landmarks. Spondylitic changes of the cervical spine rarely affect the lamina
therefore making it a favorable target to stabilize a construct.

Intralaminar screw placement has been well described in the literature but its application may be underestimated. The authors present a case, which illustrates the ideal application of C7 laminar screw placement: advanced subaxial cervical spondylosis necessitating a long construct, small C7 lateral masses, and small C7 pedicles.

**CASE DESCRIPTION**

A 67-year-old female who fell from standing approximately 2 weeks prior to transferring to our institution is presented. Over the 2-week period, the patient complained of worsening upper extremity function and decreased ability to ambulate.

The patient was diffusely weak in all muscle groups (4/5) distal to her triceps. Brisk reflexes were present in her bilateral lower extremities but clonus and Babinski were absent. Computed tomography (CT) of the cervical spine showed advanced spondylosis C4-7 with central canal and foraminal stenosis. Of note, the lateral masses of C7 were small (8 mm) compared with adjacent lateral masses (8 mm) [Figures 1 and 2]. Also concerning were the size of the C7 pedicle, 4 mm [Figure 1]. The C7 lamina was large (6 mm thick and 30 mm in length) [Figure 1].

The patient underwent a C3-6 laminectomy with C3-6 lateral mass and C7 intralaminar internal fixation (Mountaineer, Depuy Spine, Johnson and Johnson, Raynham, MA). Lateral mass screws were placed in standard fashion and each of the C3-6 lateral masses held either a 12 or 14 × 3.5 mm screw. C7 intralaminar fixation was achieved by drilling two pilot holes (Midas Rex, Medtronic) with a 3 mm matchstick at the spinolaminar junction [Figure 2]. The first pilot hole was drilled at the caudal aspect of the spinolaminar junction, 4 mm from the caudal laminar edge. The second pilot hole was drilled at the rostral aspect of the spinolaminar junction on the opposite operative side as the initial pilot hole, 4 mm from the rostral laminar edge. The hand drill was then used to extend the hole at 2 mm increments parallel to the angle of the lamina while checking for breaches with a ball trip probe. Two 3.5 × 24 mm intralaminar screws were then placed and attached to a rod with offset connectors. No intraoperative fluoroscopy was used.

The patient slowly regained strength and continues to improve in a rehabilitation facility. Postoperative imaging

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**Figure 1:** Perioperative CT findings for optimal intralaminar screw placement; (a) Preoperative mid-sagittal CT showing severe C3-C6 spondylosis with central canal compromise. (b) Right parasagittal CT showing the narrow C7 lateral mass (4.0 mm)-arrow versus the patients other levels (average 8 mm). (c) Axial CT through the C7 pedicle showing it to be narrow and small (4 mm). (d) Axial CT through the C7 lamina showing excellent anatomical characteristics for laminar screw placement: 6 mm laminar width and 30 mm lamina length. (e) Postoperative CT showing the C7 intralaminar screw placement, 3.5 × 24 mm Depuy Mountainer. This screw is almost double the length placed in the lateral masses of the adjacent levels, 3.5 × 14 mm, and similar to that of what the pedicle screw would have held without the safety hazard, (Mountaineer, Depuy Spine, Johnson & Johnson, Raynham, MA)
reveals good screw placement with a good construct. Neural elements are well decompressed.

**DISCUSSION**

Patients with cervical spondylotic myelopathy necessitating a laminectomy for decompression of the neural elements are at risk of developing a postlaminectomy kyphotic deformity. Panjabi and White posited that the removal of the posterior elements shortens the normally longer posterior moment arm and lengthens the anterior moment arm. These forces result in kyphosis. Those with preexisting kyphosis are prone to exaggeration of the deformity and those with straight or lordotic curvatures may develop kyphosis. The development of a deformity may result in a decline in neurological and functional status. Spondylosis of the spine does not prevent the evolution of deformity. Kaptain et al. demonstrated that 21% of laminectomy patients will develop kyphosis and those with straight spinal alignment are at approximately twice the risk of developing kyphosis as those with lordotic alignments. A meta-analysis by Anderson et al. provided Class III evidence that fusion decreases the incidence of postlaminectomy kyphosis. As such, internal fixation after multi-level decompression in patients with advanced spondylitic arthropathy is encouraged to prevent development of a kyphotic deformity.

The most commonly reported targets for C7 screw placement when long segments of the subaxial cervical spine require internal fixation are the pedicle and lateral mass. C7 pedicle screw fixation has been documented to be the gold standard for providing rigid spinal fixation in long constructs of the subaxial cervical spine. However, insertion of these screws is technically challenging and poses the risk of neurovascular injury if placement is in-accurate. The variables, which make placement of the C7 pedicle screw a challenge, are small bone surface area of pedicle and its location within critical structures. There is variability of the course of vertebral artery; placing this vessel in danger should pedicle screw insertion be attempted. Furthermore, there is variability in the size of the C7 pedicle across patients, and sometimes within the same patient rendering the insertion of a screw unfeasible or with undue risk.

An alternative to the pedicle screw at C7 is a lateral mass screw. This placement may be technically less challenging than C7 pedicle screw placement. However, the anatomy of the C7 lateral mass is not always favorable and biomechanical studies have shown that the pullout strength is less than that of the pedicle screw.

Placement of a C7 laminar screw is an excellent alternative to the two above mentioned procedures. It is technically easier and safer than a pedicle screw. The risk to neurovascular structures is small as the screw courses dorsal to the spinal cord and vertebral artery. A ventral breach may put the spinal cord at risk and palpation of the hole should be performed before screw insertion. This screw may also be inserted without the use of fluoroscopy or navigation as the trajectory of the lamina is easily accomplished. As Hong et al. demonstrated, there is no significant difference in the axial pullout strength between the C7 pedicle and laminar screws. Preoperative radiographic evaluation is still necessary, though, as the laminae may not always be able to accommodate a screw. Senoglu et al. recommended that at least 1 mm or bone on either side of the screw be present in case of error.

Of note, the incorporation of the rod into the construct involving a C7 laminar screw may require the use of an offset connector. The head of the C7 laminar screw does not align with the adjacent screw heads; therefore, the connector allows for completion of the construct without placing excess stress on the screw.

**CONCLUSION**

C7 laminar screw placement is safe and technically feasible using preoperative CT and intraoperative landmarks not involved with normal spondylitic pathology. Intraoperative
fluoroscopy may not be needed in selected patients. Well written reports exist showing superior construct strength when compared with lateral mass and equivalent strength when compared with pedicle fixation at C7. For these reasons, the authors advocate laminar screw placement into the C7 vertebrae, as a valuable tool in treating patients with advanced pathology of the cervical spine when internal fixation is needed.

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