

## Open C2 Vertebroplasty: Case Report, Technique, and Review of Literature

### Abstract

Osteolytic lesions of C2 are challenging pathologies to manage. Vertebroplasty, a minimally invasive technique has been widely used in lytic lesions of thoracic and lumbar spine. However, there has been limited experience with percutaneous vertebroplasty at C2, and the procedure is technically difficult. We describe a safer alternative technique of open vertebroplasty for lytic lesions involving the axis. **Methods:** The procedure was performed in a 49-year-old male with a metastatic lytic lesion involving the body and dens of C2 using an anterior cervical approach. The patient had an immediate reduction in pain with complete pain relief at 2 weeks and good stability at 3-month follow-up. The patient did not have any perioperative or postoperative complications. The anterior cervical approach open C2 vertebroplasty is a safe and effective option in the management of C2 osteolytic lesions.

**Keywords:** *Axis vertebra, cervical spine, osteolytic lesions, spinal metastasis, vertebroplasty*

### Introduction

Vertebroplasty is a minimally invasive technique that can provide pain relief and produce immediate bone strengthening and vertebral stabilization<sup>[1,2]</sup> and has been widely used in the thoracic and lumbar spine for the treatment of a variety of painful lesions of the spine. Osteolytic lesions of the axis vertebra (C2) are uncommon, and experience in percutaneous vertebroplasty (PVP) treatment in the cervical spine, especially at C2 level is limited, and the procedures are technically difficult<sup>[3]</sup> with a potential to cause serious complications. We describe a much safer alternative of open anterior cervical approach vertebroplasty for painful, osteolytic metastatic lesion involving both the body and dens of C2. Postprocedure, the patient had excellent relief in pain.

### Case Report

This study was approved by our Institutional Review Board. Informed consent was obtained from the patient. A 49-year-old man, a known diabetic presented with severe neck pain of 2 days' duration. The pain was sudden in onset, nonradiating with aggravation on movements of the neck. The patient had a history of thyroidectomy for papillary carcinoma of thyroid (follicular variant) 4 years back. He had subsequently

received two cycles of radioiodine treatment and has been on thyroxine replacement. On examination, the patient had severe tenderness in upper cervical spine, with restriction of neck movements; side-to-side neck movements being more painful than flexion-extension movements. On examination, he had no focal neurological deficits. Magnetic resonance imaging cervicodorsal spine showed a contrast enhancing lesion involving the body and dens of C2 with no epidural collection or cord compression [Figure 1]. Computed tomography (CT) scan showed the destruction of the dens and right side of C2 body suggestive of a lytic lesion involving the C2 [Figure 2]. Dynamic X-ray of the craniovertebral junction showed no evidence of instability [Figure 3]. The patient underwent an open C2 vertebroplasty.

### Technique

The patient was positioned supine, with head on horseshoe, parts painted and draped. Right anterior cervical approach at C5, platysma cut, C5 body exposed by blunt dissection between the carotid and sternocleidomastoid laterally and trachea and esophagus medially. Blunt dissection carried cephalad in the midline up to C2–C3 level. Longus colli muscle separated and retractors placed. 2 mm threaded K-wire in a drill guide anchored in the midline 3–5 mm below the anteroinferior

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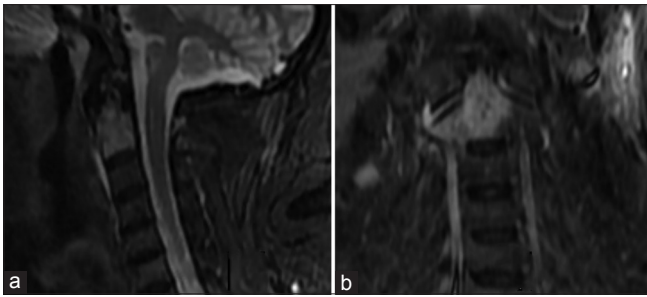
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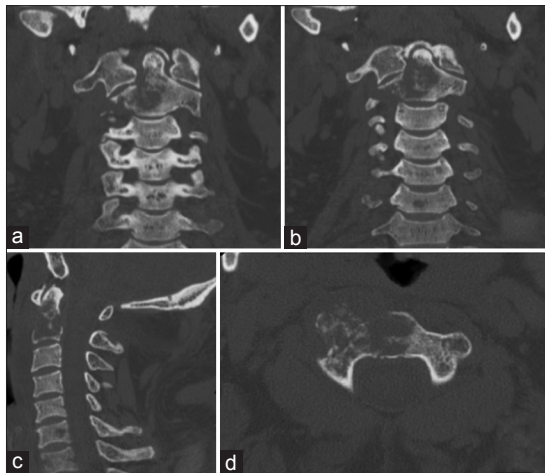
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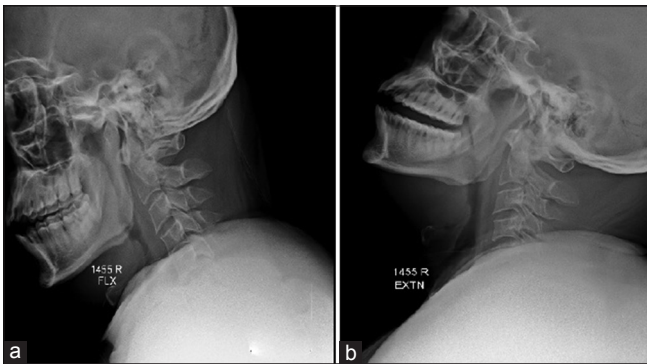
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**Figure 1: Magnetic resonance imaging cervical spine with contrast showing a contrast enhancing lesion involving the body and dens of C2 (a) sagittal (b) coronal image**



**Figure 2: Computed tomography scan cervical spine showing lytic lesion in the body and dens of C2 (a and b) coronal (c) sagittal (d) axial images**



**Figure 3: Preoperative dynamic X-ray (a) flexion (b) extension. No evidence of instability**

edge of the C2 body. K-wire drilled across the lytic region up to the distal cortex at the tip of the dens under biplanar imaging. Working cannula introduced over the K-wire. K-wire removed after confirming position. Biopsy taken polymethyl methacrylate (PMMA) (3 ml) injected under biplanar fluoroscopic monitoring [Figure 4]. No extravasation noted into the spinal canal.

Intra- and post-operative period were uneventful. Visual analog scale (VAS) was used to quantify pain. The patient reported significant relief of neck pain immediately after

the procedure (VAS improved from preoperative score of 9 to postoperative 2). The patient was continued on Philadelphia collar in the postoperative period. Immediate postoperative X-ray showed PMMA in the body and dens of C2 with no evidence of extravasation [Figure 5]. He was ambulated on the same day and was discharged on the 3<sup>rd</sup> postoperative day. At 2 weeks follow-up, the patient had complete relief in neck pain (VAS 0). At 3 months' follow-up, the patient remains asymptomatic with a stable C1–C2 complex [Figure 6].

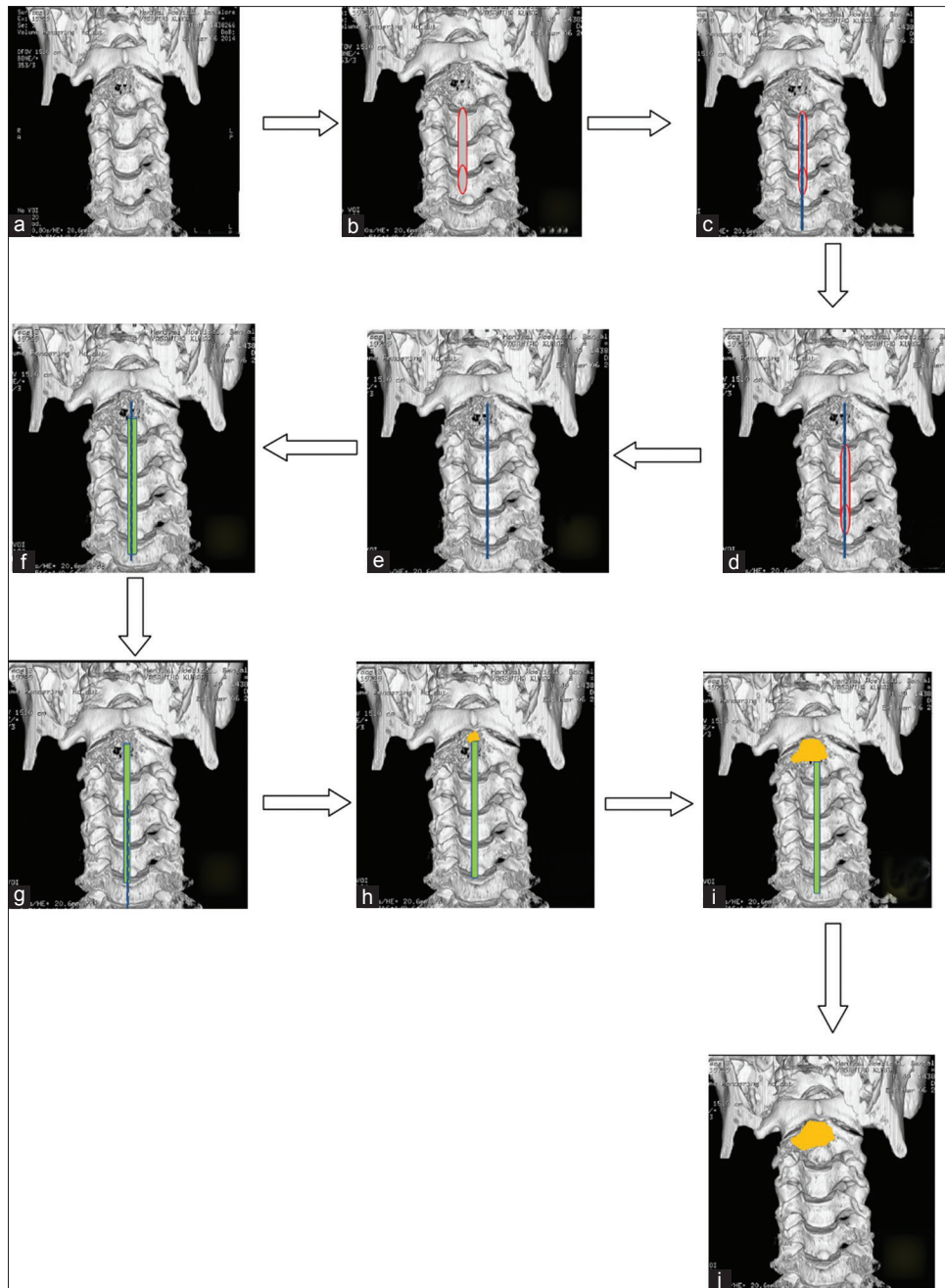
## Discussion

Osteolytic metastatic lesions of the spine are usually secondary to lung, breast, and prostate cancers. Our patient was previously operated for Papillary (follicular variant) thyroid carcinoma which has an 11%–25% incidence<sup>[4-6]</sup> of distant metastasis, most commonly to lung and bone. Osteolytic metastatic lesions of C2 are rare and have the potential to cause serious neurovascular complications.

The traditional treatment options are radiotherapy and chemotherapy. Bisphosphonates have also shown great promise in reducing bone cancer pain, bone destruction, and tumor growth. Open surgery (mainly for spinal decompression and stabilization) and vertebroplasty (to reduce pain and improve mobility) have been used as adjuncts to radio/chemotherapy.<sup>[7]</sup> Palliation with brace immobilization and medical management is also an option in patients with poor general condition and extensive disease.

Of all these various treatment options for osteolytic metastatic lesions of spine, PVP has been the most appealing, for its minimally invasiveness and its effectiveness in producing rapid and long-lasting pain relief apart from providing good bone strength and vertebral stabilization.<sup>[1,2]</sup> Although PVP technique was developed in France in 1984<sup>[8]</sup> and the first vertebroplasty (percutaneous) was at C2 level for an aggressive hemangioma with epidural extension at C2; experience with PVP at C2 level has since been limited, and the procedures are technically difficult [Figure 7].<sup>[3]</sup> PVP of C2 has been performed through the anterolateral, posterolateral, translateral, and direct transoral approaches under fluoroscopic or CT guidance<sup>[3,9-11]</sup> but these approaches are associated with a high risk of complications [Table 1].

The open anterior cervical approach C2 vertebroplasty offers an additional safer option in the management of patients with destructive lesions of C2. This comes across as a “middle path” approach; although requiring general anesthesia (GA) and an open surgery; it is less cumbersome when compared to fusion procedures requiring less operative time, shorter GA, and less blood loss while at the same time being much safer than PVP. The lower risk with open vertebroplasty at C2 can be attributed to the familiar surgical anatomy, direct visualization, and mobilization of the neurovascular structures in the neck and having a



**Figure 4: Illustration: Technique of open C2 vertebroplasty. (a) Lytic lesion of axis. (b) K-wire drill guide anchored at anteroinferior edge of the C2 body. (c) K-wire drilled across the lytic region up to the distal cortex. (d) Drill guide removed. (e) K-wire in place. (f) Working cannula introduced over the K-wire. (g) K-wire removed after confirming position. (h-j) Polymethyl methacrylate injected under biplanar fluoroscopy monitoring**

controlled environment (under GA) needed for this precise procedure. The technique itself is not very complicated, and in fact, most of the surgical steps are similar to that of odontoid screw placement; thereby facilitating injection of cement safely not only into the body of C2 but also into the dens. A volume of 2–4 ml of PMMA can be safely injected and 50%–70% mean vertebral filling is generally targeted as partial vertebral filling is seen to be associated with secondary spine deformity.

In the limited number of PVP at C2, all have been done for lesions involving the C2 body and lateral mass and none

where dens were involved. However, these studies<sup>[10-12]</sup> have shown that PVP at C2 provides rapid pain relief in up to 80% of patients and spine stability in around 87% of patients. Postprocedure occipital neuralgia has been reported in 8.3%<sup>[10]</sup> of patients. Occipital (Arnold's) neuralgia is suggested to be secondary to PMMA leakage close to C1–C2 joint and is seen to resolve in a few days with anti-inflammatory medications. About 12.5%<sup>[10]</sup> of patients may present with delayed progressive subluxation of C1–C2; requiring fusion procedures. These postprocedure cement-related complications can occur even with open C2





Figure 5: Immediate postoperative X-ray showing polymethyl methacrylate in the body and dens of C2

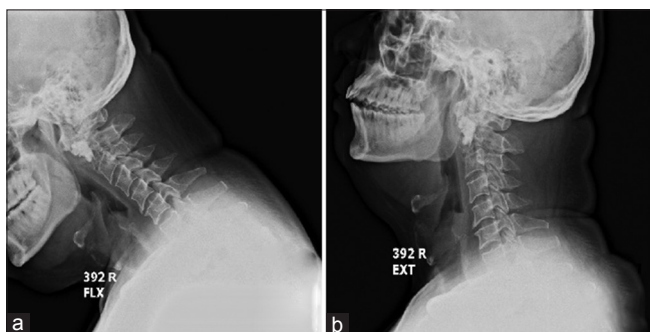


Figure 6: Dynamic X ray-3 months postoperative. (a) Flexion. (b) Extension. No evidence of instability

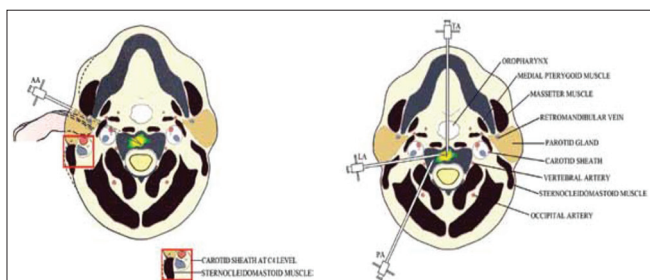


Figure 7: Percutaneous vertebroplasty approaches highlighting the various neurovascular structures that need to be negotiated during the procedure. Courtesy: Vertebroplasty for treatment of osteolytic metastases at C2 using an anterolateral approach. Gang Sun, *et al.* Pain Physician 2013;16:E427-34

vertebroplasty, and it is important to keep these patients on regular follow-up for at least a year with dynamic imaging to monitor and ascertain long-term stability.

As with our patient, other recent reports<sup>[13-15]</sup> have also highlighted the safety and efficacy of open C2 vertebroplasty in dealing with osteolytic lesions involving this complex biomechanical region of the spine.

### Conclusion

Open anterior cervical approach C2 vertebroplasty is a safer option of performing vertebroplasty at this level. It is

**Table 1: Procedure related complications with various PVP approaches<sup>[3,9-11]</sup>**

Approach	Complications
Anterolateral approach	C2 neuralgia, cerebellar infarction
Posterolateral approach	Vertebral artery injury
Translateral approach	Carotid artery, IJV injury
Transoral	Risk of infection-retropharyngeal abscess, meningitis

technically less demanding and has lower risk of procedural complications than PVP. It also has the added advantage of being able to treat lesions involving not only the body but also the dens of C2 while providing rapid and lasting pain relief and vertebral stabilization.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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