

Case Report

Translateral approach of percutaneous vertebroplasty for odontoid reconstruction: review of a case series

Zhu Zeng¹, Biao Yang², Zhengyin Liao¹

Departments of ¹Abdominal Oncology, ²Gastroenterology, West China Hospital, West China Medical School, Sichuan University, Chengdu, China

Received September 26, 2019; Accepted December 8, 2019; Epub December 15, 2019; Published December 30, 2019

Abstract: Background: Percutaneous vertebroplasty (PVP) of the upper cervical spine proves to be known for rapid pain relief. But there are no reports mainly focusing on odontoid reconstruction. Case description: Four patients were admitted to our institution for C2 metastasis. All of them had severe pain and high risk of paraplegia even sudden death due to extensive destruction of C2 from radiological examination especially in the dens. PVP via translateral approach was chosen to obtain pain relief and gain bone stabilization. Results: After PVP, CT scanning showed good cements filling and the dens reconstruction. Substantial pain was significantly relieved (decreased from VAS scores 7, 7, 9, and 10 preoperatively to 2, 2, 3, and 4, respectively), and restricted head rotation was improved. No procedures-related complications were observed during follow-up. Conclusion: For those with extensive metastasis involved with the C2 dens, PVP may be an effective therapeutic option for remodeling the odontoid to maintain its regular function.

Keywords: Osteolytic lesion, odontoid, percutaneous vertebroplasty

Introduction

Spinal metastasis is currently the leading site among skeletal metastases [1, 2]. Among these lesions, less than 1% of which are in the upper cervical spine [1-4]. Upper cervical spine is considered to be far more dangerous compared to thoracic vertebrae and lumbar as its complex anatomy [3]. The odontoid process is an upward fingerprint in the axis connecting atlas and axial vertebrae, and maintains the stability of the atlantoaxial joint [5]. The damage of dens axis always results in severe pain and further affects the quality of life due to atlantoaxial instability and possible destruction of the centrum [3-5]. Either surgery or radiotherapy, the conventional therapeutic options, has been reported to have several complications such as massive hemorrhage associated with surgery, potential osteoradionecrosis or spinal cord oedema due to radiation [6, 7]. Hence, for osteolytic metastasis to the odontoid, there are no uniform guidelines. Percutaneous vertebroplasty (PVP) has characteristics of minimally invasiveness and rapid pain relief [8]. There are few literatures

introducing vertebroplasty of C2, and no cases highlight the role of PVP in odontoid reconstruction. Here we presented a consecutive case series who received PVP via translateral approach and yielded satisfactory reconstruction of the C2 dens.

Case reports

All patients presented with severe pain that was resistant to conservative therapy and restricted head rotation for at least 4 weeks. The VAS scores of those patients were approximately 7-10. Considering the widespread metastasis and their physical condition, with the goals of palliation of symptoms, the multidisciplinary team suggested PVP after discussion.

Case 1

An 85-year-old male patient was admitted to our hospital with a history of paroxysmal left parietooccipital headache and suboccipital pain for 1 month, and he was diagnosed with primary lung cancer. The pain was worsened

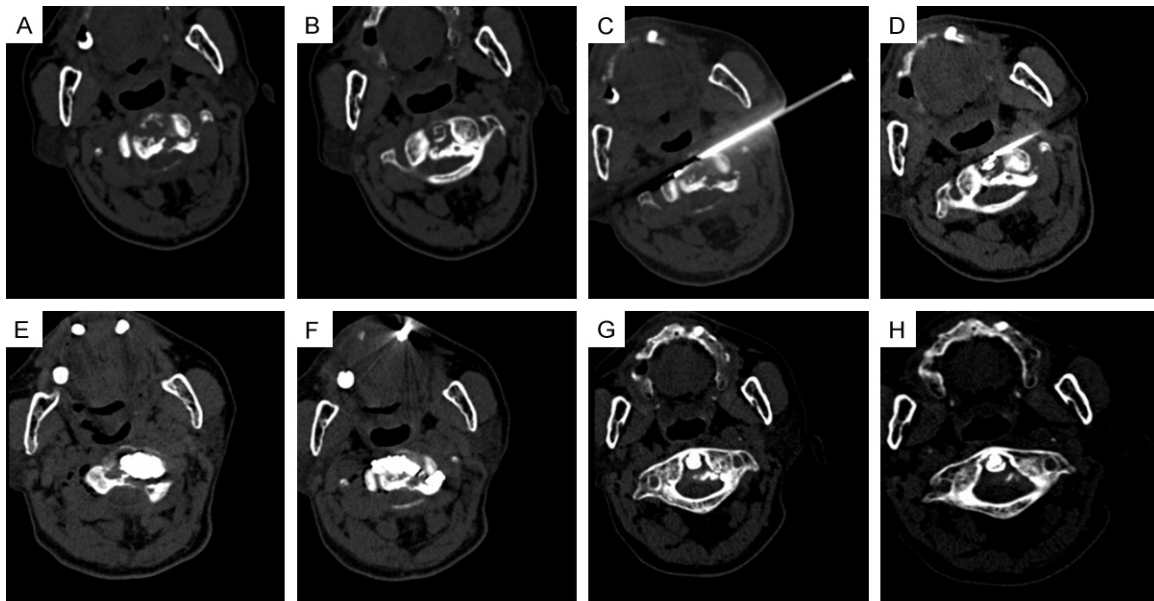


Figure 1. CT-guided percutaneous vertebroplasty (PVP) via translateral approach in an 85-year-old male patient with lung cancer with metastasis to the C2 dens. A, B. Preoperative cervical enhanced CT demonstrating the extent of osteolytic tumor through part of the dens axis. C, D. Reconstructed CT image of the needle reaching the basilar part of the C2 dens via translateral approach. E-H. Cervical CT after cementoplasty showing reconstruction of the involved odontoid.

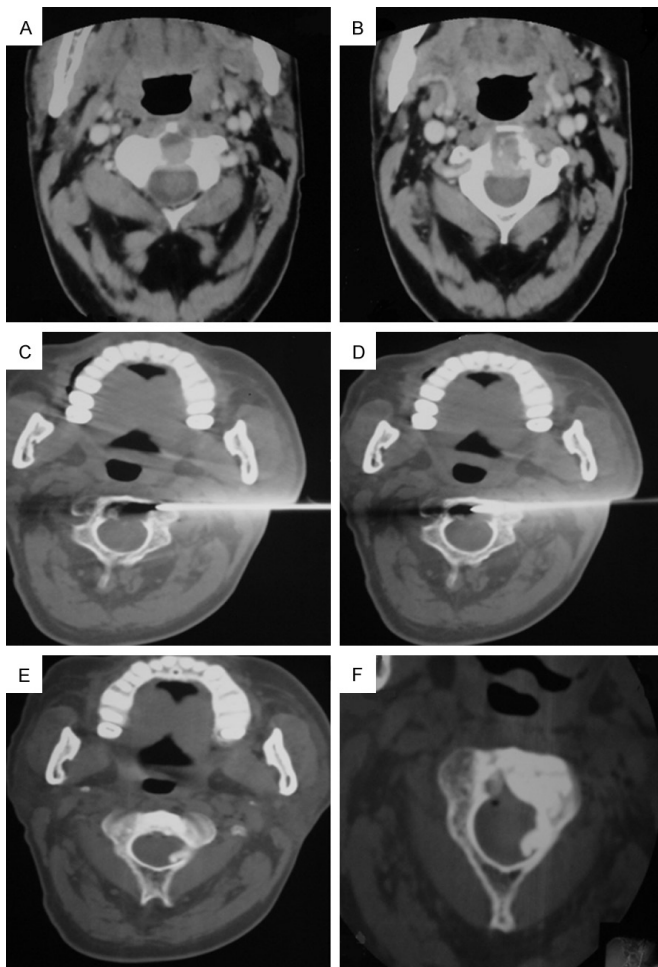


Figure 2. The procedure of PVP in a 48-year-old man with osteolytic metastasis of the C2 dens primary to lung cancer. A, B. CT scan of cervical spine showing an extensive osteolytic lesion involving the base of the dens in C2. C, D. An intraoperative CT scan of the cervical spine showing needle access and injection path. E, F. Post-operative cervical CT scanning showing through the filling of polymethyl methacrylate (PMMA) implant of the involved area (the C2 dens) and indicating a minor leakage of PMMA into the spinal canal.

with rotating head, changing position or ambulation and could be relieved by lying down. It limited daily physical activity and impaired quality of life. The performance status (PS) score was approximately achieving at least 2. The VAS score has achieved 7 while in outbreaks VAS score has achieved 9. Fluorodeoxyglucose positron emission tomography (FDG-PET/CT) showed high uptake of 18F-FDG in dens axis. Estimating from cervical enhanced CT, it indicated extensive osteolytic destructions in the skeletal system, while the main site causing current symptoms was C2 due to the serious damage of the dens (Figure 1A and 1B).

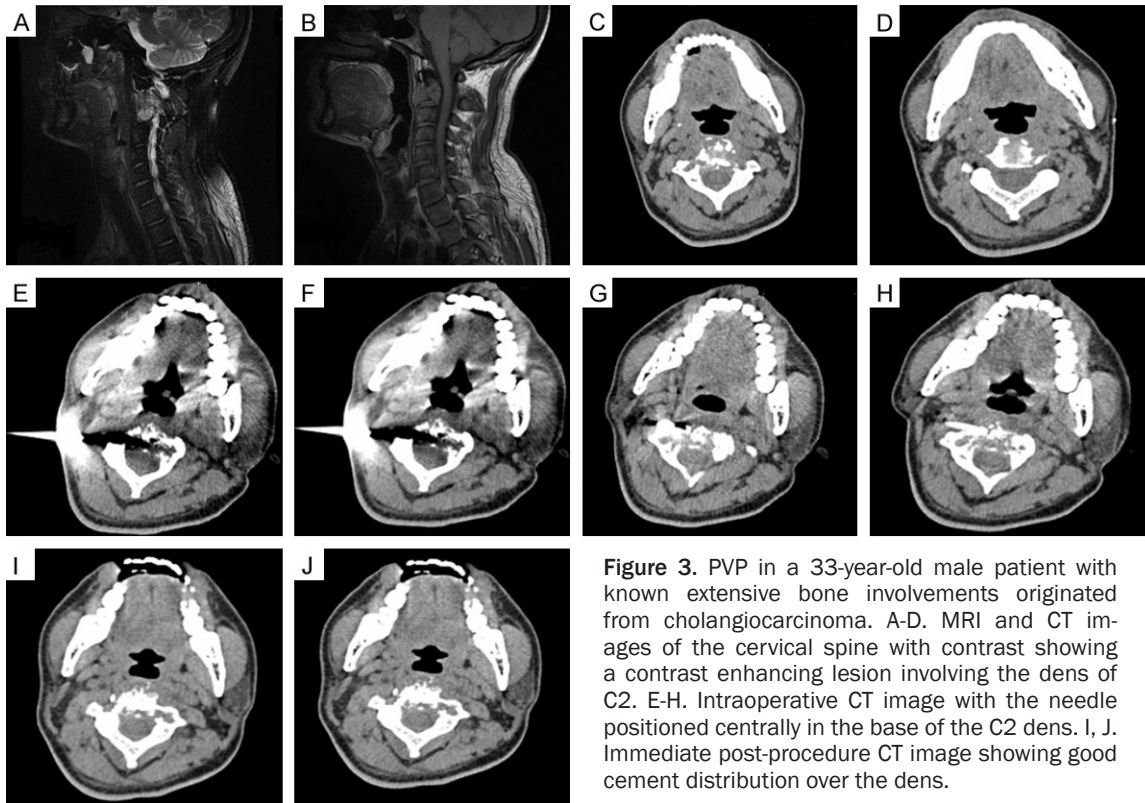


Figure 3. PVP in a 33-year-old male patient with known extensive bone involvements originated from cholangiocarcinoma. A-D. MRI and CT images of the cervical spine with contrast showing a contrast enhancing lesion involving the dens of C2. E-H. Intraoperative CT image with the needle positioned centrally in the base of the C2 dens. I, J. Immediate post-procedure CT image showing good cement distribution over the dens.

Case 2

A 48-year-old man presented with suffering from intense neck pain and incapability of rotating head secondary to C2 tumoral metastasis from lung adenocarcinoma including vertebral body and dens of C2. Cervical CT and MRI showed obvious destruction and coloboma in the dens (**Figure 2A and 2B**).

Case 3

A 33-year-old male patient with known pulmonary, retroperitoneal lymph nodes and extensive bone metastasis primary cholangiocarcinoma was referred to our department with the chief complaint of increasing nearly unbearable neck pain without focal neurological deficit. Cervical enhanced CT and enhanced magnetic resonance imaging (MRI) of the cervical spine revealed massive osteolytic destruction of C2 especially the dens axis (25 mm×34 mm) (**Figure 3A-D**).

Case 4

A 64-year-old male patient who accepted resection of bladder cancer 1 year ago was newly

hospitalized for suffering from progressive neck pain and immobility. The cervical MRI showed bone destruction of axis and PET-CT indicated C2 pathological fracture, dental process fracture and atlantoaxial misalignment (**Figure 4A-C**).

Methods

Four patients completed enhanced CT or MRI scanning for evaluating the positional relationship of the carotid sheath and the vertebral artery, and for accessing the extent of tumoral invasiveness before operation.

The procedure was performed with continuous CT guidance to make sure an accurate needle insertion position and avoid directly penetrating vital structures adjacent to the lesion. We selected translateral approach via the space between the carotid sheath and the vertebral artery under local anesthesia (3-5 ml of lidocaine 1%). A single 18-gauge 20 cm needle (Wilson-Cook Medical, Inc., IN) was slowly inserted into the skin until bone contact, along the posterior margin of the carotid sheath and in the direction of the anterior rim of the medial vertebral artery at the C2 level. Then the

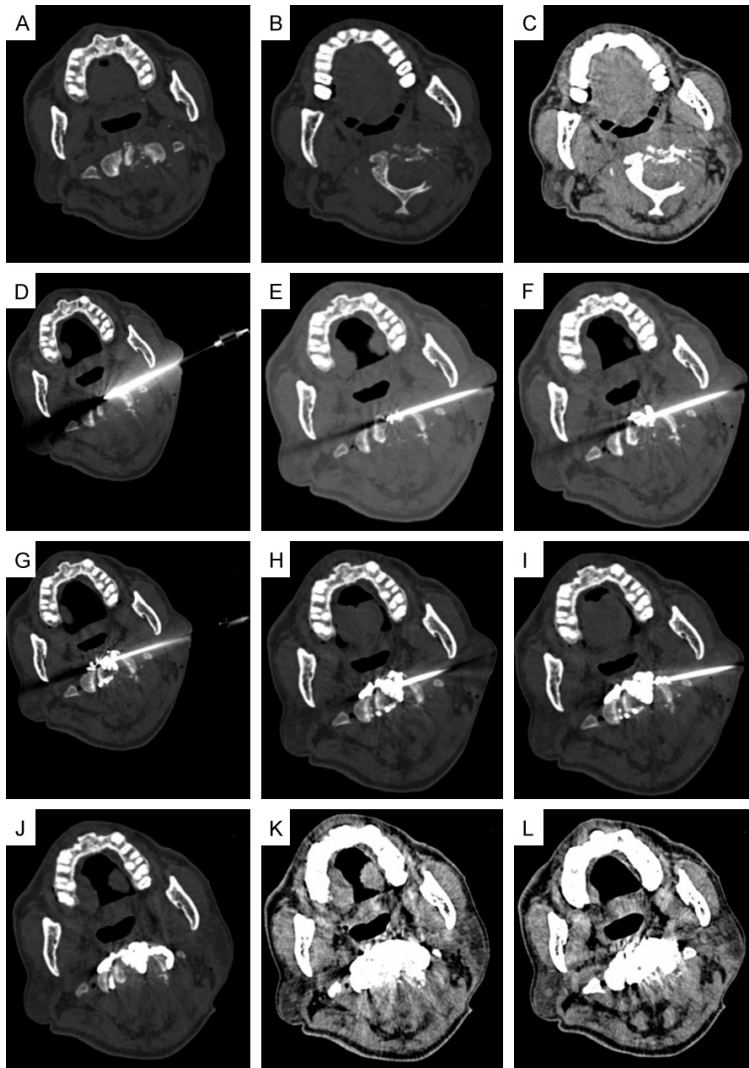


Figure 4. PVP in a 64-year-old man diagnosed as bladder cancer. A-C. The cervical CT showing C2 dental process fracture. D-I. Needle insertion path and PMMA injection. J-L. Post-procedure CT confirming satisfactory odontoid reconstruction.

needle tip was adjusted step by step and was advanced until it reached the measured distance on CT imaging. Subsequently, bone cement (Tecres S.P.A., Italy) was prepared by mixing polymethyl methacrylate (PMMA) powder with standard ratio of powder and liquid (roughly 2:1) till the mixture achieved the consistency of toothpaste. Then the tip of needle gradually reached the basilar part of the dens (Figures 1C, 1D, 2C, 2D, 3E-H, 4D-I). 1.5-3 ml of the mixture was injected by several times under CT scanning until optimal filling in osteolytic parts.

A postprocedural CT reconstruction was performed in order to confirm cements distributi-

on and monitor the leakage of cement (Figures 1E-H, 2E, 2F, 3I, 3J, 4J-L).

Results

All patients yielded satisfactory reconstruction of the odontoid, and they gained significant pain relief (the VAS scores of them all dropped to 2-4 after operation) and functional improvement (three of them improved restricted rotation of head). During follow-up, there were no occurrence of severe postoperative complications such as paraesthesia in extremities, numbness of lower legs or paraplegia.

Discussion

Bone metastasis is a frequent site of metastasis [1-3]. Metastasis of the cervical spine is uncommon (approximately 10%) [1-3], while metastatic osteolytic involvement of axis is extremely rare. The odontoid is an articular process of C2, which is linked to C1 and maintains the stability of the atlantoaxial joint via the transverse ligament of the atlas [5]. The atlas rotates around the dens, especially through rotation [3-5]. Compared to destruction of the vertebral body alone, the osteolytic tumor growth of the

dens is more likely to induce disabling pain, osteoporotic vertebral collapse and progressive subluxation, leading to progressive cord compression with a fatal outcome [4]. Hence, osteolytic lesions of the upper cervical spine, especially the C2 dens, often require aggressive treatment due to severe pain and high risk as a result of atlantoaxial instability.

Current clinical management for the osteolytic metastasis of the C2 body and dens consists of surgery, radiotherapy, and vertebroplasty [2, 8]. A variety of surgical procedures have been published in literature, including open dorsal surgery, direct decompressive surgery and open vertebroplasty by transoral or anterior approach

Table 1. Puncture path of percutaneous vertebroplasty in the upper cervical spine

Author	Year	Location of lesions	Approach
Rodriguez-Catarino M, et al. [17]	2006	C2	Transoral
Donald C. Sachs M, et al. [20]	2006	The Axis	Transoral
Anselmetti GC MA, et al. [21]	2012	the Second Cervical Vertebra (C2)	Transoral
Wen-Hao Guo, et al. [19]	2012	the Upper Cervical Spine (mainly C1-C3)	Translateral

[2, 6, 9]. Yet, dorsal decompression has been abandoned for the possibility of rapid destabilisation of spinal column, vascular insufficiency in the spinal cord and direct cord compression [2]. And it is hard to completely resect the metastatic tumors of the C2 body and the dens via transoral approach due to its difficulty of anterior fixation as a result of narrow and limited operative space [10]. Besides, the transoral path often accompanies with infection or wound healing failure. Patchell RA [9] has reported a randomized trial, which established the role of direct decompressive surgery for spinal cord compression. Unless a massive mass compresses the spinal canal and causes severe neurological symptoms, surgery will be rarely considered for those at end-stage because of possible risks of massive hemorrhage, neurologic deficits and severe postoperative sequelae [6, 10, 11]. The benefits should outweigh the risks and costs [2]. Administered alone or combined with surgery, local radiotherapy including stereotactic radiosurgery (SRS) and stereotactic body radiotherapy (SBRT) is an effective option [7]. It delivers focused and high-energy radiation to the targeted area where the tumor cells are killed and normal cells still survive, but it rests on tumor histology and radiosensitivity. Moreover, the pain can be generally relieved within 10-14 days and significant remineralization will be observed several months after radiotherapy [10, 12]. Radiation delays bone strengthening or reconstruction and may also lead to potential osteoradionecrosis [7]. Patients who are at high risk of vertebral collapse combined with spinal instability or cord compression are not eligible for radiotherapy [12, 13], nor is it suitable for those with advanced multi-metastasis disease and limited life expectancy [10, 12-14].

At present, no uniform guidelines for those with serious damage of the C2 dens are available, and PVP is an alternative option. PVP is a minimally invasive method demonstrated to be effective when performed in painful osteolytic metastasis of C2 [14, 15]. This procedure pro-

vides bone reconstruction of the C2 dens to maintain vertebral stability between atlas and axial vertebrae by PMMA [16]. The exothermic reaction of bone cement after a polymerization reaction could release heat at 40 to 110 degrees centigrade in the bone tissue and ultimately results in thermal necrosis [17, 18]. PVP is less time consuming (generally within half an hour). According to puncture path, there used to be almost all the literatures which choosed either a direct transoral or an anterolateral approach [14-16, 19] (**Table 1**). Wen-Hao Guo and colleagues [19] have discussed the feasibility and safety of different approaches and recommended translateral approach. But in our present work, we adopted translateral approach, a more convenient and easier accessibility, to improve the feasibility and effectiveness of PVP in odontoid reconstruction to relieve pain and thus improve function. No literatures previously aimed to solve this issue. Compared with surgery, PVP can be performed under local anesthesia with smaller wound and less bleeding. Moreover, PVP is superior to radiotherapy in the bone reconstruction. For those with serious osteolytic damage of the C2 dens who are unsuitable for surgery or radiotherapy, PVP is proposed to be a palliative therapy and be part of the local therapy associated with systemic therapy. Although the effect of PVP is encouraging, spinal cord nerve injury caused by bone cement leakage should not be overlooked.

Conclusion

PVP via translateral approach for osteolytic lesions of the C2 dens is characterized with rapid pain relief and bone reconstruction. However, a large scale RCT is needed.

Acknowledgements

This study was sponsored by Department of Science & Technology of Sichuan Province of China (2017SZ0014) to LZ.Y.

Written informed consent was obtained from all patients.

Disclosure of conflict of interest

None.

Abbreviations

PVP, percutaneous vertebroplasty; PMMA, poly-methyl methacrylate; CT, computed tomography; MRI, magnetic resonance imaging; PS, performance status score.

Address correspondence to: Dr. Zhengyin Liao, Department of Abdominal Oncology, Cancer Center, West China Hospital, West China Medical School, Sichuan University, Guoxue Xiang No. 37, Chengdu 610041, Sichuan, China. Tel: +86-13981717611; Fax: +86-028-85423609; E-mail: liaozhengyin@163.com

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