

Research Article

Results of percutaneous cervical vertebroplasty using an anterolateral approach for cervical spine tumors

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ABSTRACT

Objective: The aim of this study was to report the results of percutaneous vertebroplasty in managing symptomatic osteolytic cervical spine tumors.

Methods: This study comprised a retrospective examination of patients who received percutaneous vertebroplasty between 2008 and 2020 for the treatment of tumor-induced symptomatic cervical vertebra involvement. The study summarized the demographics, vertebral levels, pain control rates, clinical results, and complications of percutaneous vertebroplasty using an anterolateral approach.

Results: The study sample consisted of 6 female and 2 male patients aged between 20 and 56 (mean = 41.37) years. Tumors were located at C2 in 6 cases, at C3 in 1 case, and at C5 in another. The mean volume of poly (methyl methacrylate) injected was 1.5 mL (range: 1-2 mL). Biopsy results showed the presence of metastasis in 5 cases and plasmacytoma in 3. No postoperative complications or mortality were observed after the procedure. Preoperative mean 7.75 visual analog scale score decreased to 2.62. Pain control was reported to be 66.2%.

Conclusion: Anterolateral cervical vertebroplasty seems to be a safe, effective, and helpful therapeutic alternative for the treatment of cervical spine tumors. It reduces the risk of infection compared to the transoral method.

Level of Evidence: Level IV, Therapeutic Study

Introduction

Spinal metastasis is observed in over two-thirds of patients who die from cancer.¹ In 10%-20% of these cases, the spinal cord is affected by pathologic fracture covering the posterior wall.² Approximately 60% of metastases are found in the thoracic spine segment of the spine.³ Location in the thoracic spine is followed by the lumbar (20%) and cervical spine (10%-20%).^{1,4-6} However, involvement is extremely rare in the upper cervical vertebra.^{7,8}

Percutaneous vertebroplasty (PVP) is a minimally invasive procedure for the treatment of dorsopathy stemming from osteoporotic vertebral fracture, vertebral metastases, multiple myeloma, and aggressive hemangioma. However, PVP is a well-established technique for the treatment of benign and malignant compression fractures, as well as for the consolidation and palliation of painful lytic tumors.^{9,10} Developed in France in 1984, PVP was designed to treat aggressive hemangioma with epidural extension in the C2 localization.¹¹ The aim is to deaden the pain by strengthening the vertebra. Percutaneous vertebroplasty indications are extended to cover patients with osteoporotic fractures and vertebral metastases.¹²

Percutaneous vertebroplasty is performed in the upper cervical vertebra by anterolateral and transoral approaches.¹³ The anatomical structure of the cervical region increases the risk of complications. In osteolytic lesions, cement is more prone to leak into the spinal tract, putting pressure on the spinal cord and nerve roots. In these cases, PVP is highly risky due to regional anatomy and the risk of cement leakage.¹⁴⁻¹⁷

When applied with an appropriate method, cervical PVP is a viable procedure with acceptable complication rates in pain control. This study examined the clinical results of patients receiving PVP in the cervical region using an anterolateral approach.

Materials and Methods

Ethical approval for the study was obtained from Ümraniye Training and Research Hospital Ethics Committee (B10.1.TKH.4.34.H.GP.0.01/54 ID). Preoperatively, informed consent about the operation and the use of their data was obtained from the patients. The study comprises a retrospective examination of patients who received PVP between 2008 and 2020 for the treatment of tumor-induced symptomatic cervical vertebrae involvement. The study examined

Table 1. Demographics and clinical aspects of cases

Case	Age	Gender	Level	Histopathology	Pre-op VAS	Post-op 24-h VAS	Post-op 3rd month VAS
1	55	M	C2	Carcinoma metastasis	8	4	2
2	31	F	C2	Plasmocytoma	7	2	1
3	37	F	C2	Carcinoma metastasis	8	3	2
4	56	F	C3	Carcinoma metastasis	8	2	2
5	20	M	C2	Plasmocytoma	8	3	1
6	46	F	C2	Carcinoma metastasis	7	2	1
7	52	F	C2	Plasmocytoma	8	2	1
8	33	F	C5	Carcinoma metastasis	8	3	1

VAS, visual analog scale; M, male; F, female.

preoperative neurological figures, Karnofsky scores, and pre- and postoperative scores on the visual analog scale (VAS). Cervical computed tomography was scanned to ascertain the absence or presence of instability and posterior cortex integrity. The calculation method developed by Cohen (d-value) was used for the study's effect size.¹⁸ The preoperative and 24-hour VAS findings of 8 cases in the study were used to calculate the impact power of the study. Power analysis was done with the G-Power package program (version 3.1).

Surgical technique

A 1 cm skin incision was performed at the level of the C5-C6 intervertebral disc under both local anesthesia and fluoroscopic control. After feeling the internal carotid artery pulsation, the artery was retracted to the lateral. After the esophagus and trachea were retracted to the medial side, Jamshidi cannula was inserted into the C2 corpus. The cannula was inserted as far as the anterior surface of the C5 vertebral body. The cannula was then slipped along the anterior surface of vertebral bodies up to the target vertebra. After positioning the tip of the cannula in the midline in the anteroposterior axis and the lower endplate of the target vertebra in the lateral position, the cannula was inserted into the vertebral body. A K-wire was then inserted, and the Jamshidi cannula was replaced with the working cannula. After final positioning, a biopsy was taken using tumor grasping forceps. Then, after drilling, between 1 and 1.5 mL of poly (methyl methacrylate) (PMMA) was injected (Figure 1). All patients were mobilized within 4 hours and discharged the following day (Video *).

Results

In the 2008-2020 period, vertebroplasty was performed in 350 patients. Cervical vertebroplasty was performed in 8 (2.28%) of the 350 cases, where 6 patients were female, 2 were male, and the average age was 41.37 (20-56) years. Tumors were located at C2 in 6 cases, at C3 in 1 case, and at C5 in another. All patients were given biopsy and vertebroplasty using the anterolateral approach. The patients were injected with between 1 and 1.5 mL of PMMA. Biopsy results showed the presence of metastasis in 5 cases and plasmacytoma in 3. In postoperative neurological examinations, no regression, no cement leakage from the vertebrae, and no cement embolism

were observed. The preoperative 7.75 VAS score dropped to a postoperative score of 2.62. The pain control rate was 66.2% (Table 1). The d-value, which is the effect size index, was calculated as 7.93 for the Wilcoxon signed-ranks test, in which the difference between the 2 measurements (pre VAS → 7.75 ± 0.46 vs. post VAS → 2.63; $P = .010$) levels is measured. In this context, the power was found to be $1 - \beta = 0.99$ for $\alpha = 0.05$ (the margin of error) and $d = 7.93$. While the mean preoperative KPS was 76.25 (70-80), it was found to be 85 (80-90) postoperatively. Neurological deterioration was not detected in any patient. No complications, infections, or surgical mortality were seen on postoperative follow-up.

Discussion

Although cervical bone metastases are very rare lesions, the methods used for pain control and treatment of these patients are very limited. Cervical vertebroplasty is an effective method that can be used in the pain control and treatment of these patients. However, in the literature review, articles about the clinical success and complications of this method are limited. This study demonstrates the safety of cervical PVP using the anterolateral approach and its effectiveness in pain control.

Multiple myeloma and metastasis are the most frequent types of malignant tumors in the vertebrae.^{19,20} These tumors are present mostly in the thoracic and lumbar vertebrae. In many cases, pain control is assured, and vertebral height is restored by vertebroplasty.²¹ Vertebroplasty is rarely applicable in the cervical region. In a single clinical study that performed PVP in 117 patients for vertebral metastasis, 10% of the patients were given PVP in the cervical region and only 2% at C2.²² In our series, C2 PVP was performed in only 6 of the 350 cases (1.7%). This is because metastasis and/or multiple myeloma involvement is rare in the C1 and C2 vertebrae,²² and the region is risky for operation.

With the exception of some meta-studies, there are few small PVP series in the literature (Table 2). Anterolateral,^{16,21,23-25} posterolateral,²⁴ and transoral^{13,17} approaches are identified for cervical PVP. Anterolateral^{16,21,23-25} and transoral^{13,17} approaches have recently been recommended in the upper cervical region. In the anterolateral approach, the risk of damaging neurovascular, esophageal, and tracheal structures is high in the cervical region, whereas the risk of infection is low.¹⁶ In the transoral approach, the risk of damaging such visceral structures is lower but that of infection is higher.²⁶ In the lower cervical region, both anterolateral and posterolateral approaches are preferable with regard to the location of the lesion.²⁴

The aim of cervical PVP is to control pain and restore vertebral height.²¹ In many studies, 85%-89% pain control was reported.^{19,22,27} Masala et al¹³ reported 40% pain control. The pain

HIGHLIGHTS

- Percutaneous vertebroplasty in the cervical spine is a technically demanding and complication prone procedure. However, when applied with an appropriate method it is a viable procedure with acceptable complication rates. This study examined the clinical results of patients receiving PVP in the cervical region using an anterolateral approach.
- The results from this study showed a decrease in pain scores and an increase in performance scores with no complications in 8 patients who underwent PVP via an anterolateral approach.
- This indicates that the cervical PVP using the anterolateral approach is a safe and effective option for providing pain control in cervical spine tumors.

Table 2. List of reported series of cervical vertebroplasty

Author	Case #	Level	Approach	Diagnosis	Complication
Tong et al (2000) ¹⁴	1	C2	Transoral	MM	None
Mont'Alverne et al (2005) ¹³	12	C2	Anterolateral PVP	Carcinoma metastasis	1 transient occipital neuralgia, 1 ischemic stroke, 7 asymptomatic cement leakage
Rodriguez Catarino (2005) ¹⁹	1	C2	Anterolateral PVP	MM	1 asymptomatic cement leakage
Pflugmacher et al (2006) ¹⁷	5	C3-7	Anteriorlateral PVP	MM	Asymptomatic cement leakage in 2 of 12 levels
David Dang et al (2007) ²³	1	C2-C3	Posterolateral	Fibrous dysplasia	None
Masala et al (2010) ¹⁰	62		Monolateral (anterolateral or posterolateral) PVP or transoral PVP		2 asymptomatic cement leakage
Sun et al (2010) ²⁰	10	C2	Anterolateral and posterolateral	Carcinoma metastasis	3 slight odynophagia, 4 asymptomatic cement leakage
Blondel et al (2012) ²⁴	6	C2-5	Anterolateral	Carcinoma metastasis	2 asymptomatic cement leakage
Kordeki et al (2015) ²²	15	C2-7	Anterolateral	Carcinoma metastasis, MM, vertebral hemangioma	None
Lí Bao et al (2017) ²¹	9	C2-6	Anterolateral	Carcinoma metastasis	Asymptomatic cement leakage in 14 of 22 levels (63.6%)

MM, multiple myeloma; PVP, percutaneous vertebroplasty.

control rate was 66.2% in the present study. As cervical PVP is performed on smaller vertebrae than thoracic and lumbar vertebrae, cement leakage may occur due to a lack of experience and the small size of these vertebrae. Many studies have reported 17% asymptomatic cement leakage (Table 2).

Using the PubMed and Medline databases, Garza-Ramos et al²⁸ examined 125 cervical PVP cases, 83 of which were performed at C2. In that series, asymptomatic cement leakage into the paraspinal lesion

was observed in 22 patients, and symptomatic cement leakage was found in 5 cases (4%). Odynophagia was observed in 3 of the 5 cases with symptomatic cement leakage. In addition, there was leakage-based occipital neuralgia in one case and cement embolism in another.

In a 12-case C2 PVP series, Mont'Alverno et al¹⁶ reported asymptomatic cement leakage in 7 cases and symptomatic complications in 2 (occipital neuralgia in 1 case and ischemic stroke the other). Using

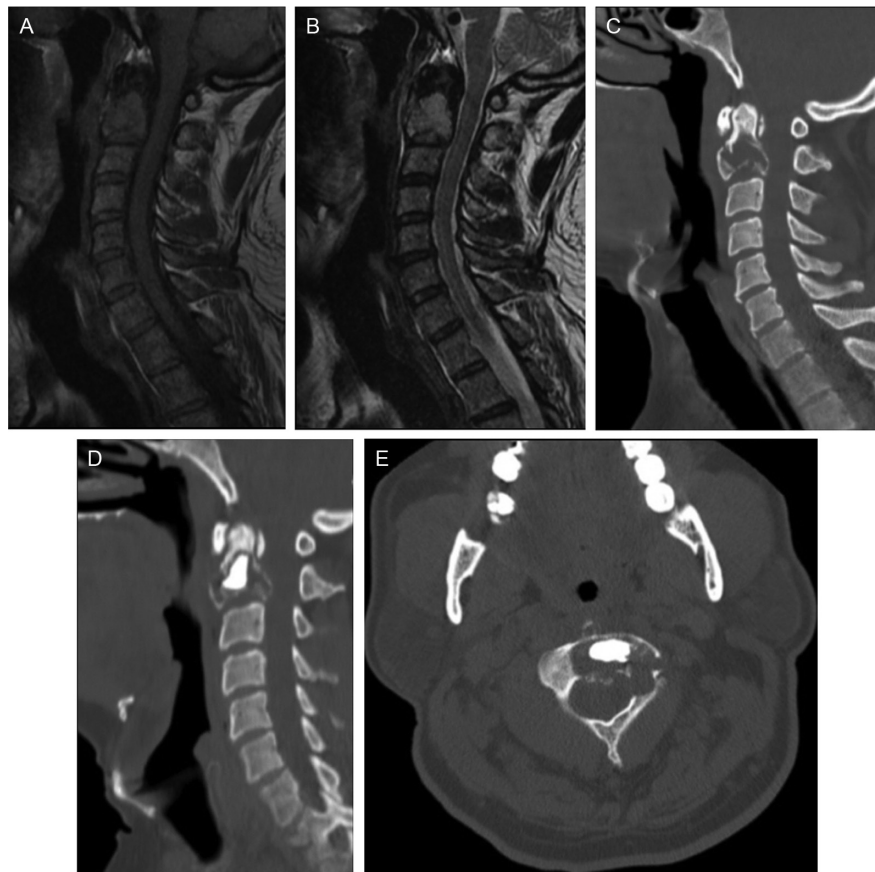


Figure 1. A-E. Preoperative and postoperative images of a case of C2 plasmocytoma. (A) Preoperative T2-weighted sagittal MRI showing the tumor. (B) Preoperative cervical spine CT showing osteolytic changes of C2 vertebra. (C) Postoperative cervical spine CT showing cement inside of C2 body and odontoid process. MRI, magnetic resonance imaging; CT, computed tomography.

the transoral approach for cervical vertebroplasty has a risk rate of between 2 and 4.5%.²⁹⁻³¹ In our series, no complications, infection, or surgical mortality were seen on postoperative follow-up.

The most important limitation of our study is the small number of cases and retrospective planning. However, this situation is inevitable due to the small number of these patients and the rarity of using this method as a treatment. Therefore, prospective studies with multicentric and large numbers of cases are required.

Anterolateral cervical vertebroplasty seems to be a safe, effective, and helpful therapeutic alternative for the treatment of cervical spine tumors. It reduces the risk of infection compared to the transoral method.

*Supplementary video file associated with this article can be found in the online version of the journal.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Ümraniye Training and Research Hospital, (Approval No: B10.1.TKH.4.34.H.GP.0.01/54 ID).

Informed Consent: Written informed consent was obtained from the patients.

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References

- Hage WD, Aboulaia AJ, Aboulaia DM. Incidence, location, and diagnostic evaluation of metastatic bone disease. *Orthop Clin North Am.* 2000;31(4):515-528. vii. [\[CrossRef\]](#)
- Harrington K. Metastatic tumors of the spine: diagnosis and treatment. *J Am Acad Orthop Surg.* 1993;1(2):76-86. [\[CrossRef\]](#)
- Cole JS, Patchell RA. Metastatic epidural spinal cord compression. *Lancet Neurol.* 2008;7(5):459-466. [\[CrossRef\]](#)
- Ibrahim A, Crockard A, Antonietti P, et al. Does spinal surgery improve the quality of life for those with extradural (spinal) osseous metastases? An international multicenter prospective observational study of 223 patients. Invited submission from the joint section meeting on disorders of the spine and peripheral nerves, March 2007. *J Neurosurg Spine.* 2008;8(3):271-278. [\[CrossRef\]](#)
- Tokuhashi Y, Matsuzaki H, Oda H, Oshima M, Ryu J. A revised scoring system for preoperative evaluation of metastatic spine tumor prognosis. *Spine (Phila Pa 1976).* 2005;30(19):2186-2191. [\[CrossRef\]](#)
- Fehlings MG, David KS, Vialle L, Vialle E, Setzer M, Vrionis FD. Decision making in the surgical treatment of cervical spine metastases. *Spine (Phila Pa 1976).* 2009;34(22):S108-S117. [\[CrossRef\]](#)
- Fourney DR, York JE, Cohen ZR, Suki D, Rhines LD, Gokaslan ZL. Management of atlantoaxial metastases with posterior occipitocervical stabilization. *J Neurosurg.* 2003;98(2):165-170. [\[CrossRef\]](#)
- Fung KY, Law SW. Management of malignant atlanto-axial tumours. *J Orthop Surg (Hong Kong).* 2005;13(3):232-239. [\[CrossRef\]](#)
- Health Quality Ontario. Vertebral augmentation involving vertebroplasty or kyphoplasty for cancer-related vertebral compression fractures: A systematic review. *Ont Health Technol Assess Ser.* 2016;16(11):1-202.
- Tsoumakidou G, Too CW, Koch G, et al. Cirse guidelines on percutaneous vertebral augmentation. *Cardiovasc Intervent Radiol.* 2017;40(3):331-342. [\[CrossRef\]](#)
- Galibert P, Deramond H, Rosat P, Le Gars D. Preliminary note on the treatment of vertebral angioma by percutaneous acrylic vertebroplasty. *Neurochirurgie.* 1987;33(2):166-168.
- Deramond H, Depriester C, Galibert P, Le Gars D. Percutaneous vertebroplasty with polymethylmethacrylate. Technique, indications, and results. *Radiol Clin North Am.* 1998;36(3):533-546. [\[CrossRef\]](#)
- Masala S, Anselmetti GC, Muto M, Mammucari M, Volpi T, Simonetti G. Percutaneous vertebroplasty relieves pain in metastatic cervical fractures. *Clin Orthop Relat Res.* 2011;469(3):715-722. [\[CrossRef\]](#)
- Gailloud P, Martin JB, Olivi A, Rüfenacht DA, Murphy KJ. Transoral vertebroplasty for a fractured c2 aneurysmal bone cyst. *J Vasc Interv Radiol.* 2002;13(3):340-341. [\[CrossRef\]](#)
- Martin JB, Gailloud P, Dietrich PY, et al. Direct transoral approach to c2 for percutaneous vertebroplasty. *Cardiovasc Intervent Radiol.* 2002;25(6):517-519. [\[CrossRef\]](#)
- Mont'Alverne F, Vallée JN, Cormier E, et al. Percutaneous vertebroplasty for metastatic involvement of the axis. *AJNR Am J Neuroradiol.* 2005;26(7):1641-1645.
- Tong FC, Cloft HJ, Joseph GJ, Rodts GR, Dion JE. Transoral approach to cervical vertebroplasty for multiple myeloma. *AJR Am J Roentgenol.* 2000;175(5):1322-1324. [\[CrossRef\]](#)
- Cohen M. The revised conners parent rating scale: factor structure replication with a diversified clinical sample. *J Abnorm Child Psychol.* 1988;16(2):187-196. [\[CrossRef\]](#)
- Cotten A, Dewatre F, Cortet B, et al. Percutaneous vertebroplasty for osteolytic metastases and myeloma: effects of the percentage of lesion filling and the leakage of methyl methacrylate at clinical follow-up. *Radiology.* 1996;200(2):525-530. [\[CrossRef\]](#)
- Jenis LG, Dunn EJ, An HS. Metastatic disease of the cervical spine. A review. *Clin Orthop Relat Res.* 1999;359(359):89-103. [\[CrossRef\]](#)
- Pflugmacher R, Schleicher P, Schröder RJ, Melcher I, Klostermann CK. Maintained pain reduction in five patients with multiple myeloma 12 months after treatment of the involved cervical vertebrae with vertebroplasty. *Acta Radiol.* 2006;47(8):823-829. [\[CrossRef\]](#)
- Barragán-Campos HM, Vallée JN, Lo D, et al. Percutaneous vertebroplasty for spinal metastases: complications. *Radiology.* 2006;238(1):354-362. [\[CrossRef\]](#)
- Rodriguez-Catarino M, Blimark C, Willén J, Mellqvist UH, Rödger S. Percutaneous vertebroplasty at c2: case report of a patient with multiple myeloma and a literature review. *Eur Spine J.* 2007;16(suppl 3):242-249. [\[CrossRef\]](#)
- Sun G, Jin P, Li M, et al. Percutaneous vertebroplasty for treatment of osteolytic metastases of the c2 vertebral body using anterolateral and posterolateral approaches. *Technol Cancer Res Treat.* 2010;9(4):417-422. [\[CrossRef\]](#)
- Bao L, Jia P, Li J, et al. Percutaneous vertebroplasty relieves pain in cervical spine metastases. *Pain Res Manag.* 2017;2017:3926318. [\[CrossRef\]](#)
- Kordecki K, Lewszuk A, Puławska-Stalmach M, et al. Vertebroplasty of cervical vertebra. *Pol J Radiol.* 2015;80:51-56. [\[CrossRef\]](#)
- Guglielmi G, Andreola C, Muto M, Gilula LA. Percutaneous vertebroplasty: indications, contraindications, technique, and complications. *Acta Radiol.* 2005;46(3):256-268. [\[CrossRef\]](#)
- De la Garza-Ramos R, Benvenuti-Regato M, Caro-Osorio E. Vertebroplasty and kyphoplasty for cervical spine metastases: a systematic review and meta-analysis. *Int J Spine Surg.* 2016;10:7. [\[CrossRef\]](#)
- Kingdom TT, Nockels RP, Kaplan MJ. Transoral-transpharyngeal approach to the craniocervical junction. *Otolaryngol Head Neck Surg.* 1995;113(4):393-400. [\[CrossRef\]](#)
- Dang D, Baig MN, Christoforidis G, Chiocca EA, Gabriel J. C2/c3 pathologic fractures from polyostotic fibrous dysplasia of the cervical spine treated with percutaneous vertebroplasty. *Eur Spine J.* 2007;16(suppl 3):250-254. [\[CrossRef\]](#)
- Blondel B, Adetchessi T, Demakakos J, Pech-Gourg G, Dufour H, Fuentes S. Anterolateral kyphoplasty in the management of cervical spinal metastasis. *Orthop Traumatol Surg Res.* 2012;98(3):341-345. [\[CrossRef\]](#)